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ARMY SAFEGUARD SYSTEM EVALUATION AGENCY WHITE SANDS M--ETC F/G 14/1  
INITIAL CATTS COST EFFECTIVENESS TREE.(U)  
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14 SAFSEA-MEMORANDUM-TC-1-74

INITIAL CATTS COST EFFECTIVENESS TREE

10 Gilbert L. Neal

PREPARED BY  
COMMUNICATIONS, COMMAND AND CONTROL  
SYSTEMS ANALYSIS DIRECTORATE

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11 MAY 1974

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DIVISION 4  
JUN 9 1974  
P. C. 1073  
FT. BENNING, GEORGIA

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A large, stylized handwritten signature in black ink, appearing to read "Alexander Nicolini".

ALEXANDER NICOLINI  
Major, Infantry  
R&D Coordinator

SAFSEA MEMORANDUM TC-1-74

INITIAL CATTS COST EFFECTIVENESS TREE

APRIL 1974

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## INITIAL CATTS COST EFFECTIVENESS TREE

### 1.0 PURPOSE

This memorandum documents the development of a cost/effectiveness (C/E) descriptor tree which was developed in support of Operational Test 1 (OT 1) planning for Device 16A3, Combined Arms Tactical Training Simulator (CATTS). The C/E tree was developed as part of a planned SAFSEA six man-month technical assistance effort to the CATTS Program Director.

### 2.0 BACKGROUND

2.1 SAFSEA was requested to consider provision of technical assistance for the CATTS Program on 21-22 February 1974 as part of the SAFSEA-TRADOC programed activity. Subsequent coordination and planning resulted in establishing a six man-month level-of-effort for the CATTS Program by SAFSEA.

2.2 This technical assistance is to be provided as required upon recognition of specific areas where the resources can most beneficially be applied.

2.3 Two such areas have been identified and completed by SAFSEA. The first task consisted of reviewing and commenting on the CATTS OT 1 Methodology. The task was completed and comments provided to the Program Director on 2 April 1974. The second was to develop a Cost/Effectiveness Tree for the CATTS system which supports the CATTS COEA. The task was initiated on 2 April 1974 and a draft provided to the CATTS Test Division Chief (MAJ Fried) USAIS on 15 April 1974. This memorandum documents the C/E tree as provided to the USAIS.

### 3.0 C/E TREE DEVELOPMENT METHODOLOGY

3.1 A C/E tree is a variant of performance descriptor hierarchy methodology in which a taxonomy of measurable system elements is developed down to measurable data elements. A performance descriptor hierarchy considers only system performance elements while a C/E tree considers both performance and cost elements (similar to a Value Model). The "tree" is designed and constructed to be utilized as a system evaluation tool. It is an effective evaluation tool because it provides a framework for structuring an evaluation methodology. It assists in the:

- Identification of system measures of effectiveness (MOE)

used

- ° Identification of system performance descriptors (PD) and their relationship to MOEs.
- ° Establishment of an initial data element table
- ° Identification of elements of cost associated with effectiveness

3.2 The CATTs tree was constructed utilizing a "top down" approach. The top element is the cost operational effectiveness for a given set of operating conditions, measured in units which can be compared to values determined in the same manner for other sets of operational conditions. Starting from the top the major performance and cost elements entering into the analysis are identified and defined. Next, the significant performance or cost subelements entering into the major elements are identified, defined, and enumerated. The process continues iteratively until the desired level of observable performance and cost elements have been identified. The result of this process is an inverted tree diagram of system cost and performance elements.

3.3 Rules for developing the C/E tree are:

- ° Define the top measure from the system/study objective.
- ° Identify successive levels of the tree, where each level provides more detailed performance or cost descriptors.
- ° Each element of the tree must have an unambiguous definition.
- ° Each element should be independent of other elements at the same level.
- ° Each element of the tree must provide a useful measure of effectiveness or cost.
- ° Each element must be capable of being quantified.
- ° The process is terminated when directly measurable data elements have been identified and it is no longer beneficial to continue on to lower data elements.

3.4 The C/E tree must be continuously reviewed, reiterated, and updated as additional system and planning information becomes available and the evaluation methodology is developed. Thus (a) it may be necessary to add, revise, or delete elements in the tree; (b) the tree, itself, may require restructuring; and (c) element definitions, measures, and assumptions may require revision. This review and revision process is the key to useful application of the tree.

#### 4.0 CATTs C/E TREE

4.1 The C/E tree for CATTs was developed according to the procedures described in paragraph 3.3. The objectives of this tree are to:

- Provide methodological framework for CATTs evaluation.
- Become part of the cost operational effectiveness analysis (COEA) for CATTs.
- Provide the bases for development of a data gathering plan.
- Assist in structuring the planning of OT requirements.
- Provide a common evaluation schema for comparing CATTs cost and effectiveness to alternative forms of battalion staff training such as the CPX.

4.2 The CATTs C/E tree is contained in appendices A, B, and C.

4.2.1 Appendix A shows the overall structure of the tree. Due to space constraints each descriptor element of the "tree" is designated in terms of its decimal code. This code is keyed to the branch structure diagrams in Appendix B and to descriptor definitions in Appendix C.

4.2.2 Appendix B contains diagrams of the descriptor structure of each branch of the "tree." The diagrams are ordered in terms of successive levels of breakdown, where each descriptor was successively partitioned into the lower measureable elements identified. For example, the highest level block in the tree is titled, COE (1.0) into which all data elements feed. COE is based on two components -- Cost (1.1) and Training Effectiveness (1.2). Training Effectiveness (1.2) is based on measures from four sub-elements Process Functional Capability (1.2.1), Process Situational Capability (1.2.2), Process Operational Capability (1.2.3) and Process Supportability (1.2.4). Process Functional Capability (1.2.1) is composed of two descriptor components Stimulus (1.2.1.1) and Response (1.2.1.2). Each of these elements is further broken down into component descriptor elements. This process is illustrated for each branch of the "tree." This example also shows that each descriptor block is designated by its performance descriptor name and by a decimal code.

4.2.3 Appendix C lists the names, decimal breakdown code, definition, measure, and assumption underlying each descriptor identified in the initial "tree."

## 5.0 SUMMARY AND RECOMMENDATIONS

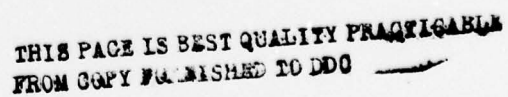
5.1 The initial user cost/effectiveness (C/E) tree was developed and provided to USAIS in support of operational test 1 (OT 1) planning for the Combined Arms Tactical Training Simulator (CATTS). The tree provides a framework for the assessment of cost factors and the training effectiveness in order to determine whether full-scale development of the CATTS should continue.

5.2 The C/E tree presented in this memorandum was produced as part of a short response time action, with initial results required by USAIS within 10 days of initiation. The tree was developed from a user standpoint, therefore, aspects concerning Research and Development were not fully developed. It is recommended that it be thoroughly reviewed periodically in light of new OT 1 planning data as it becomes available and updated and revised as required. This process assures currency and validity of the tree as it is applied to system evaluation.

## APPENDIX A

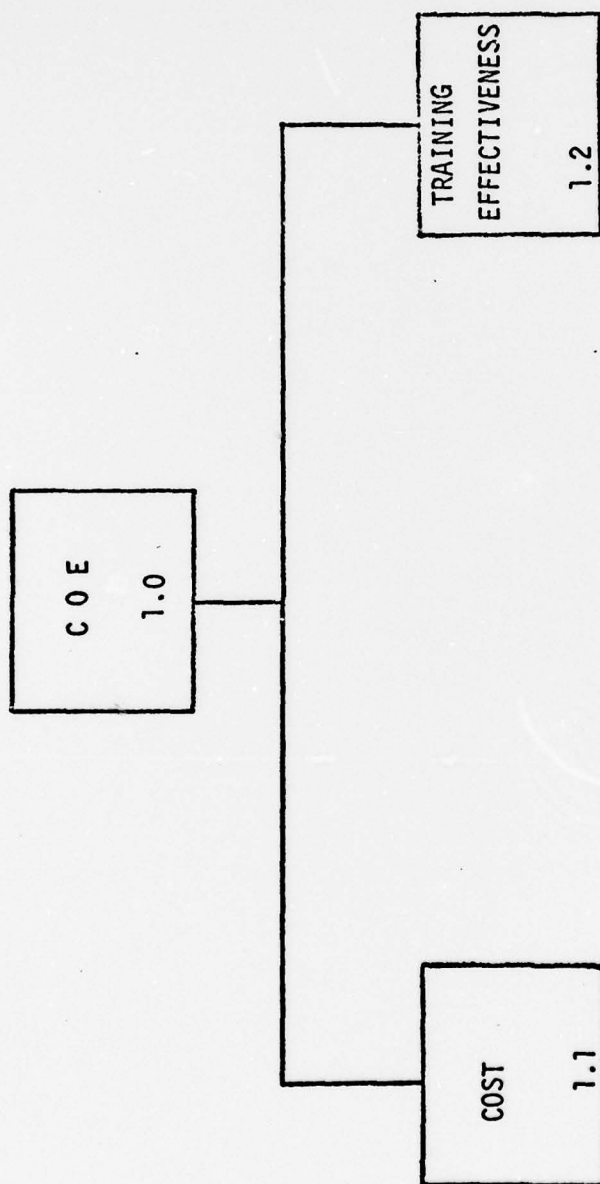
THIS APPENDIX IS A REPRESENTATION OF THE OVERALL STRUCTURE  
OF THE TREE. THE DECIMAL CODE IS KEYED TO THOSE IN  
APPENDIX B.

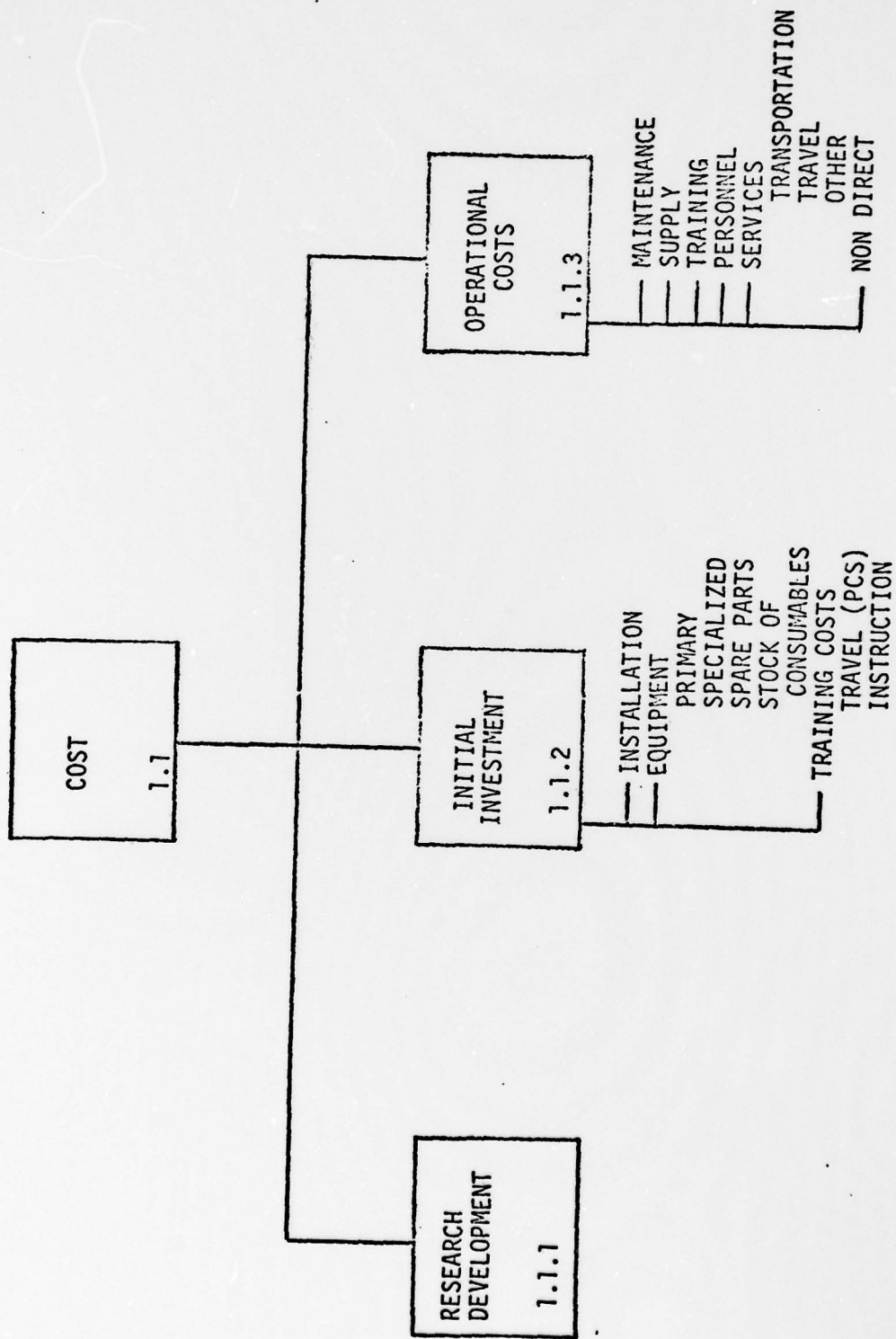
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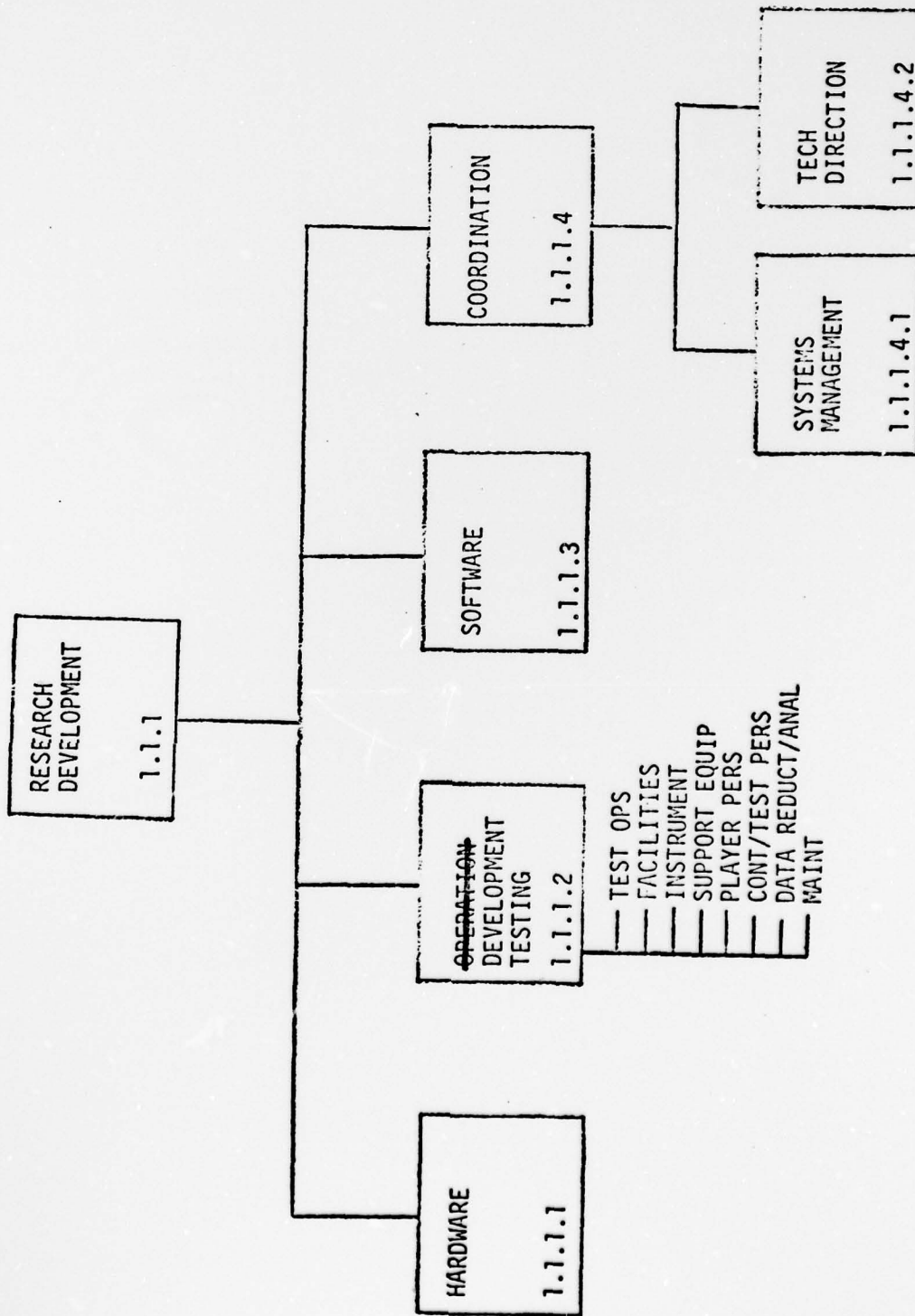


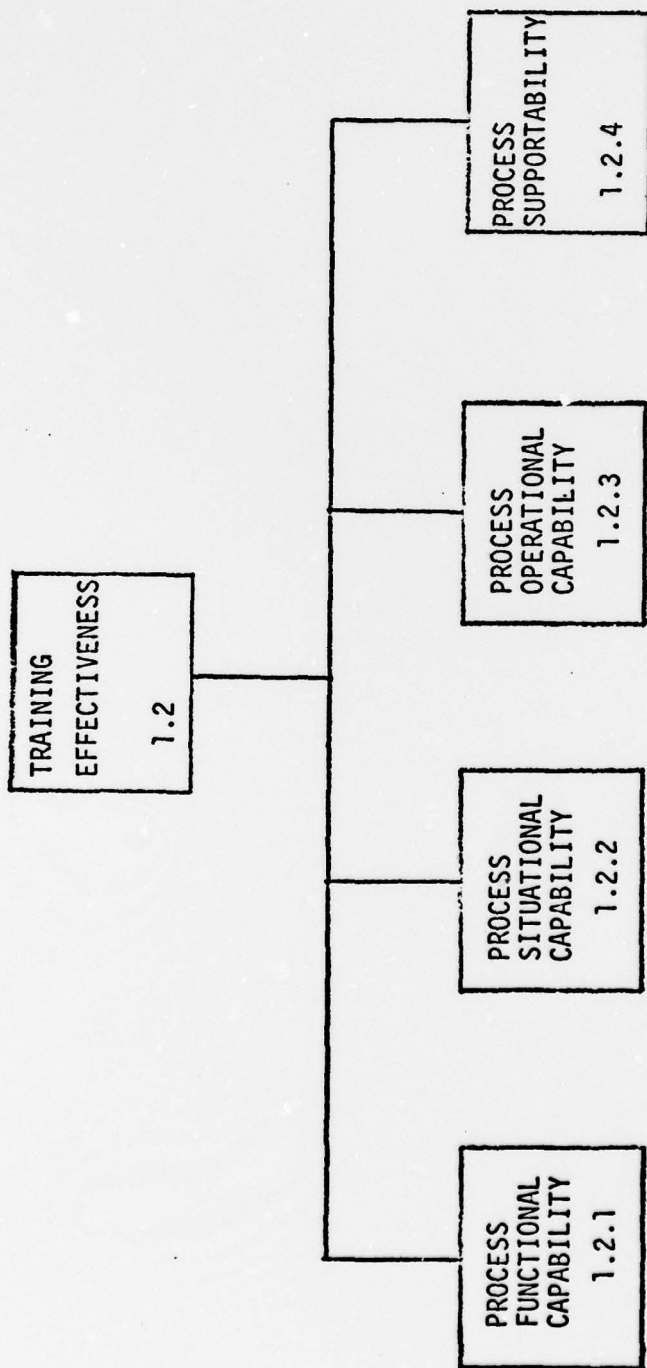
## APPENDIX B

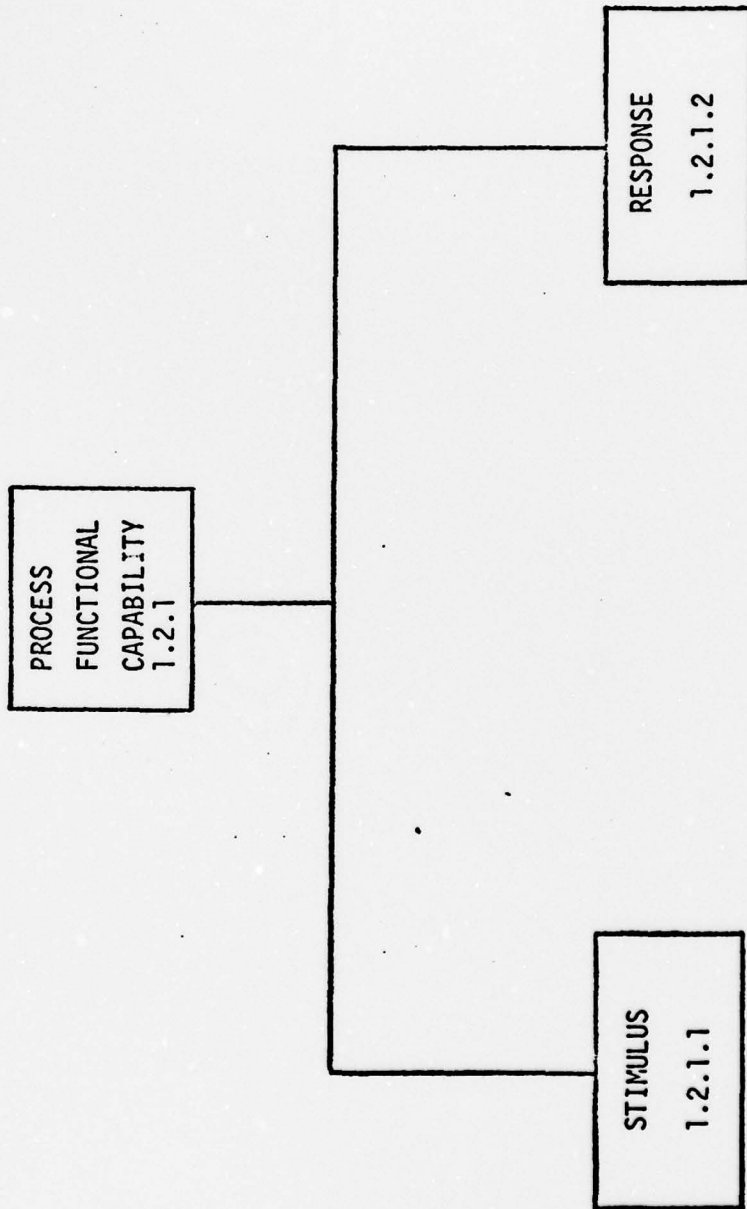
.....  
DIAGRAMS OF THE DESCRIPTOR STRUCTURE OF EACH BRANCH OF  
.....  
THE TREE. THE DIAGRAMS ARE ORDERED IN TERMS OF  
.....  
SUCCESSIVE LEVELS OF BREAKDOWN.

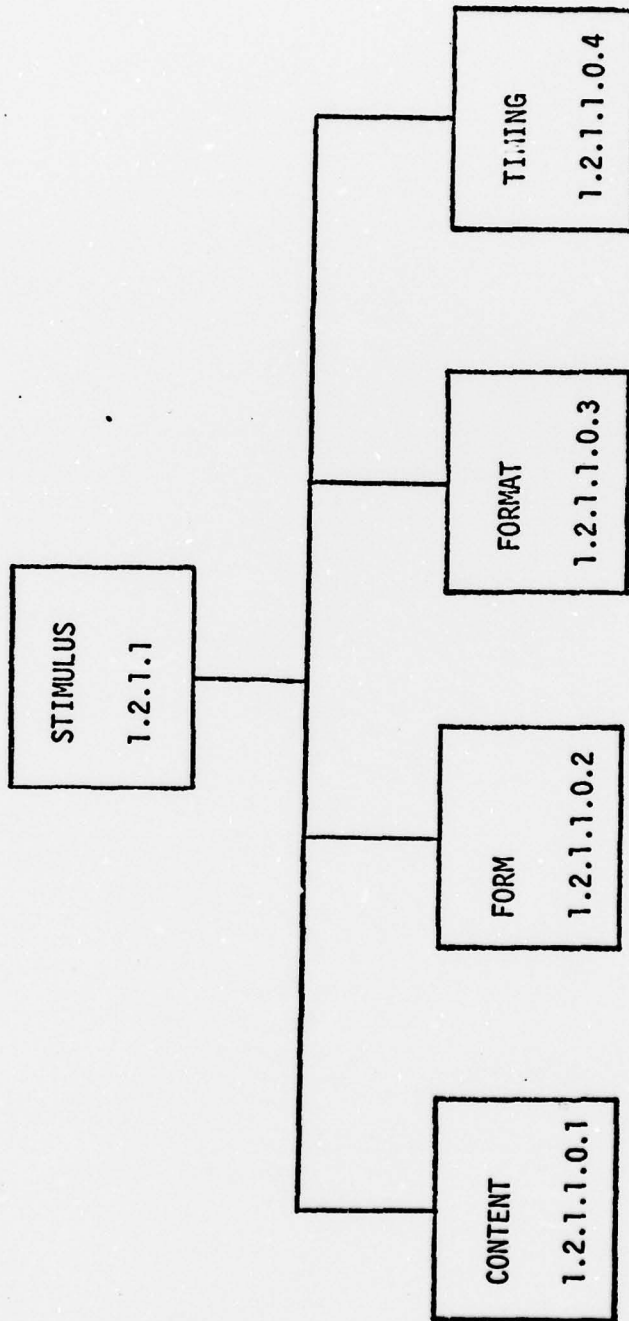


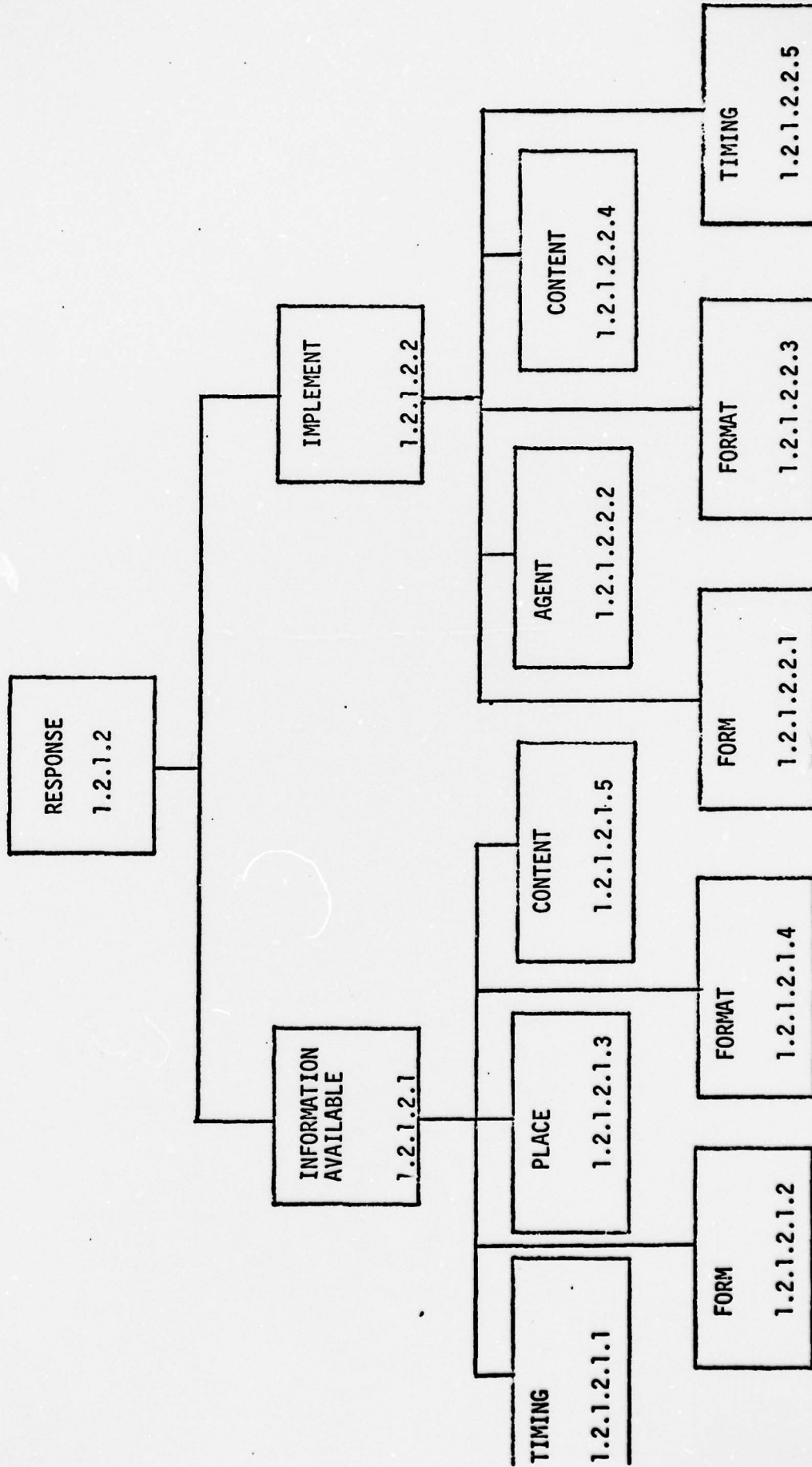


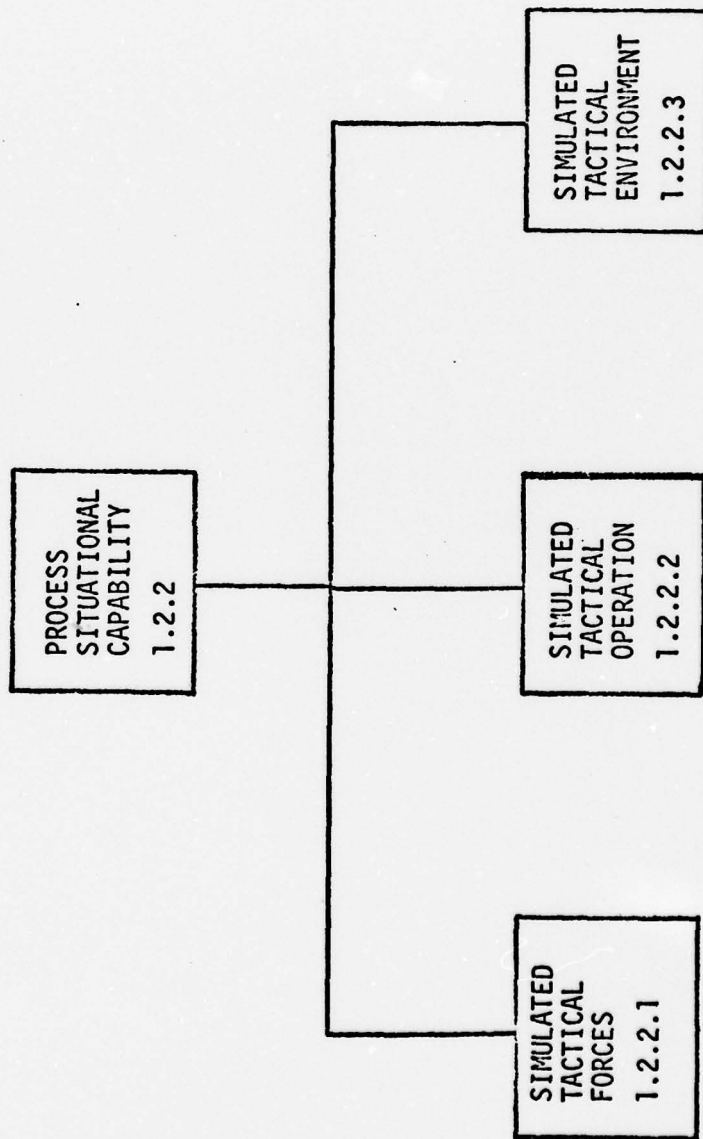


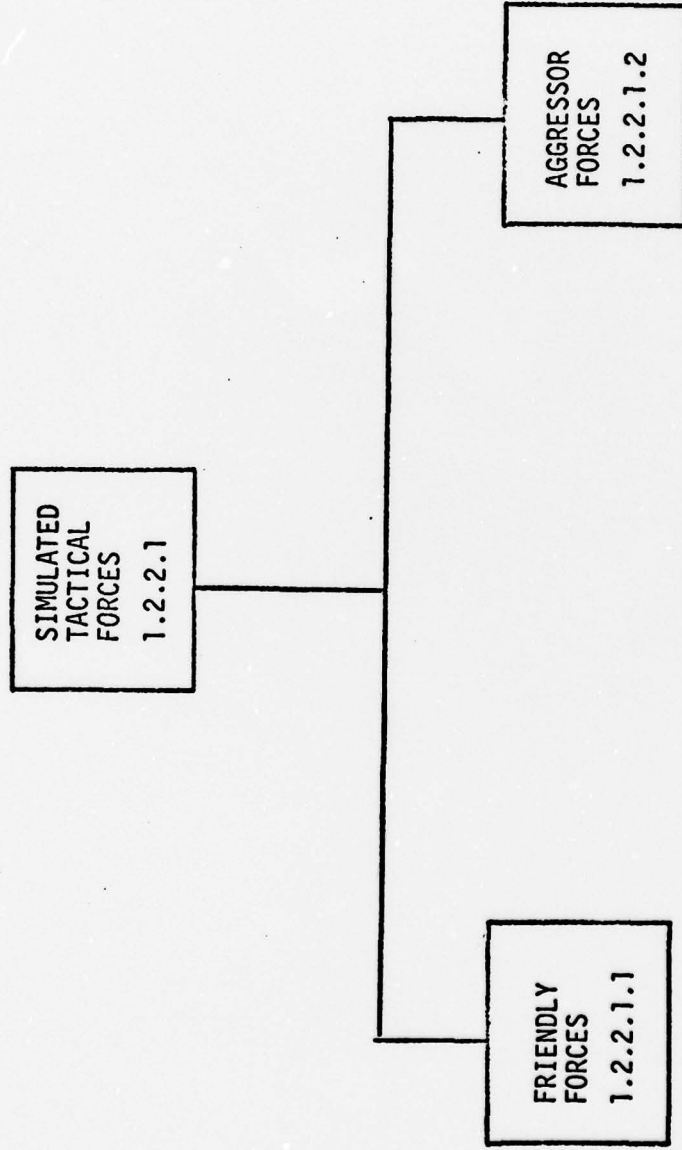


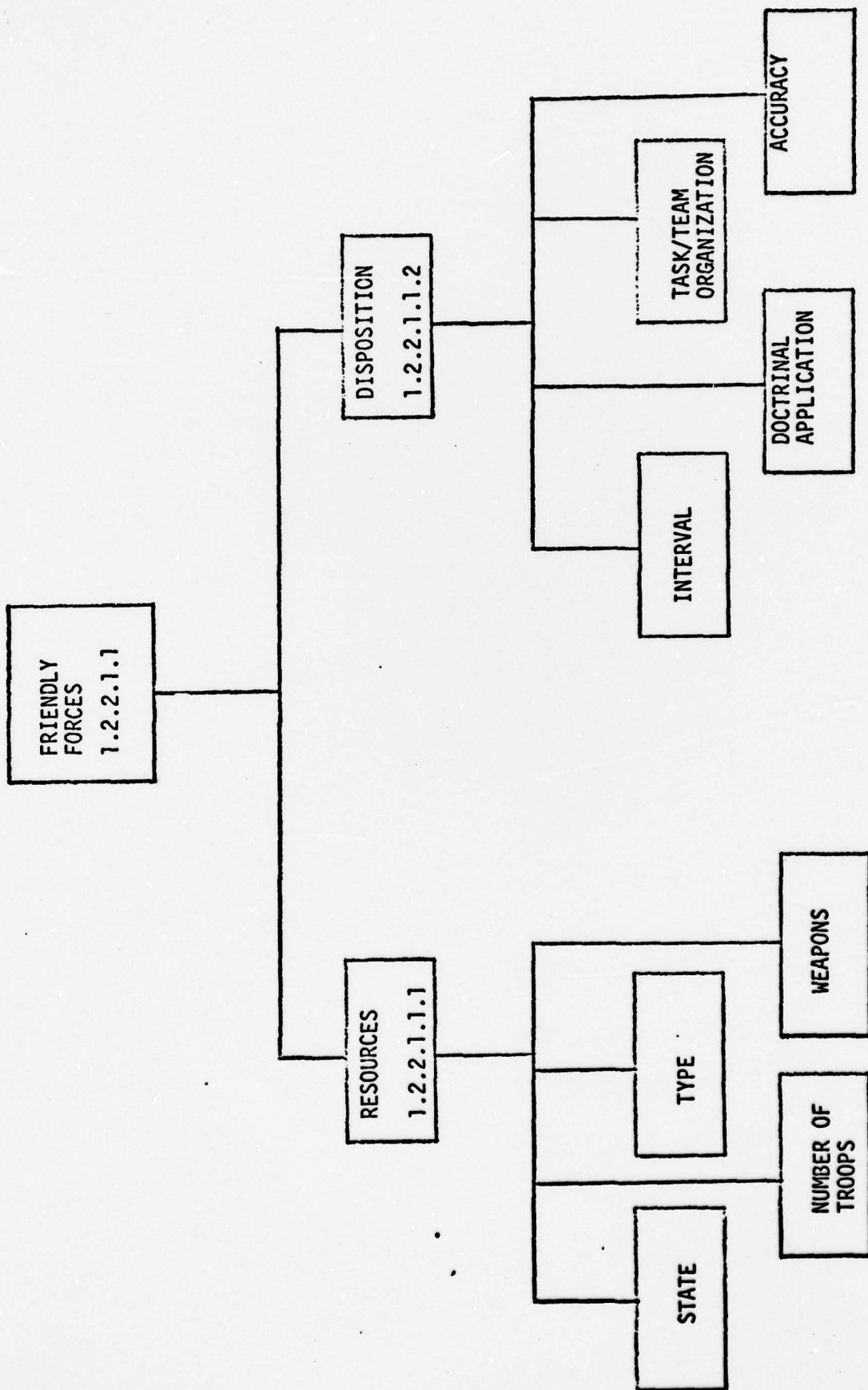


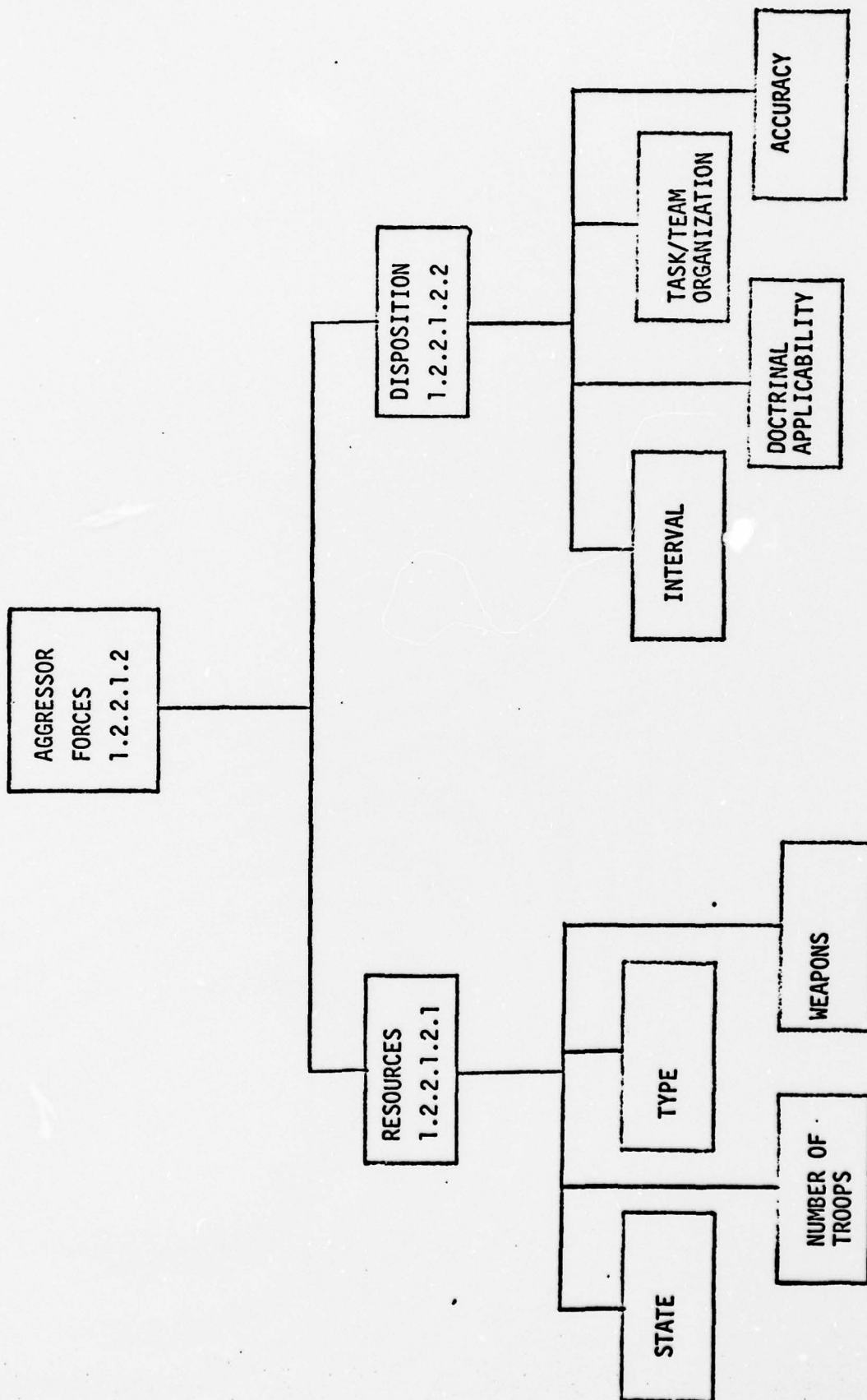


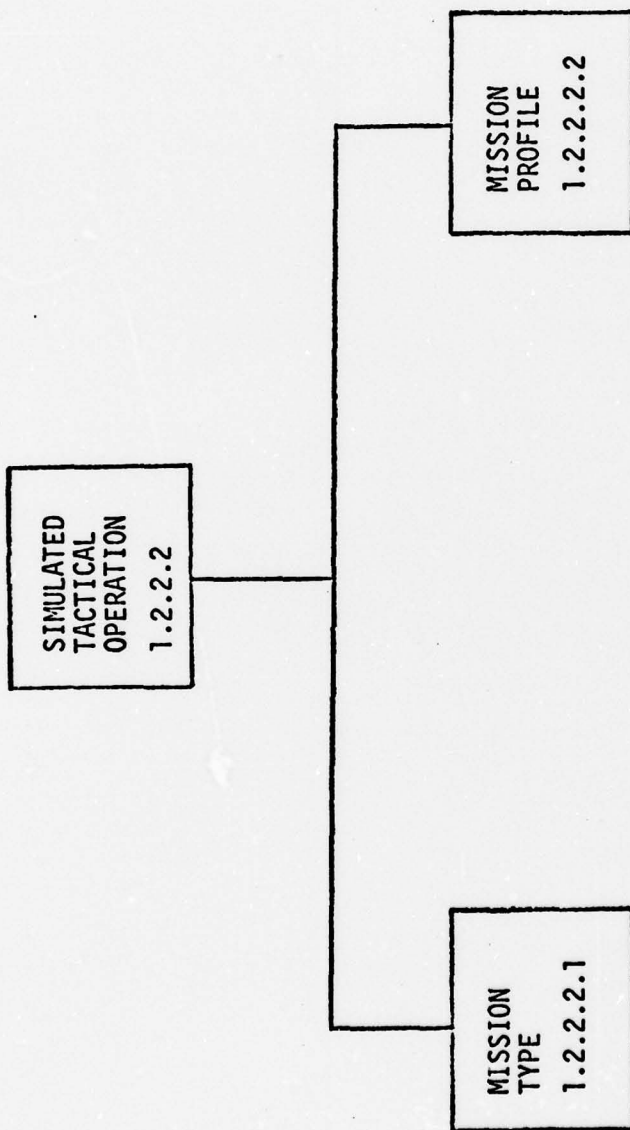


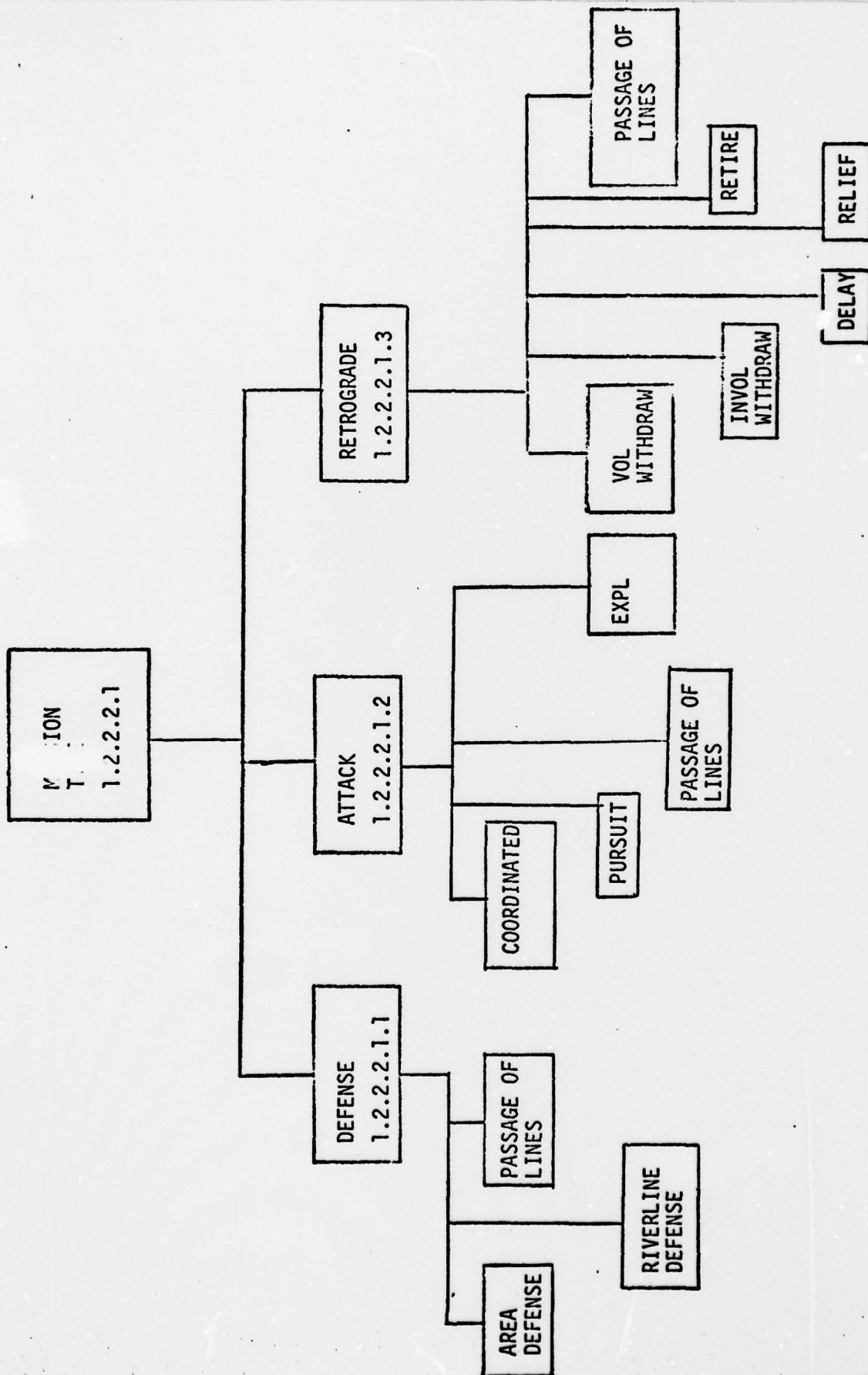


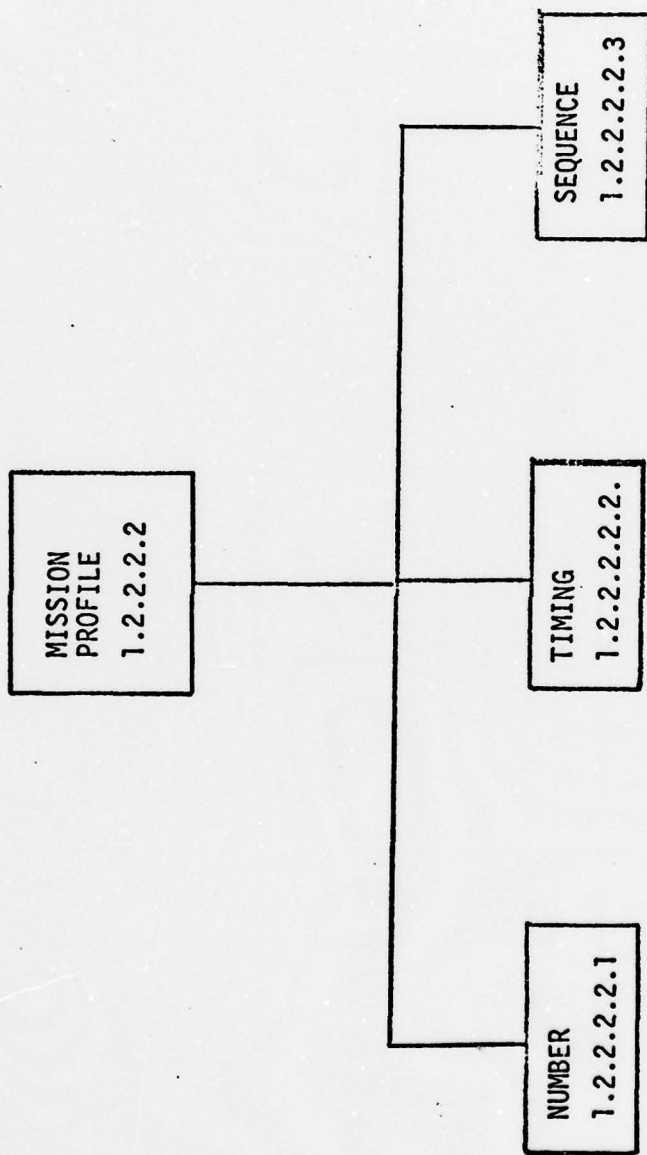


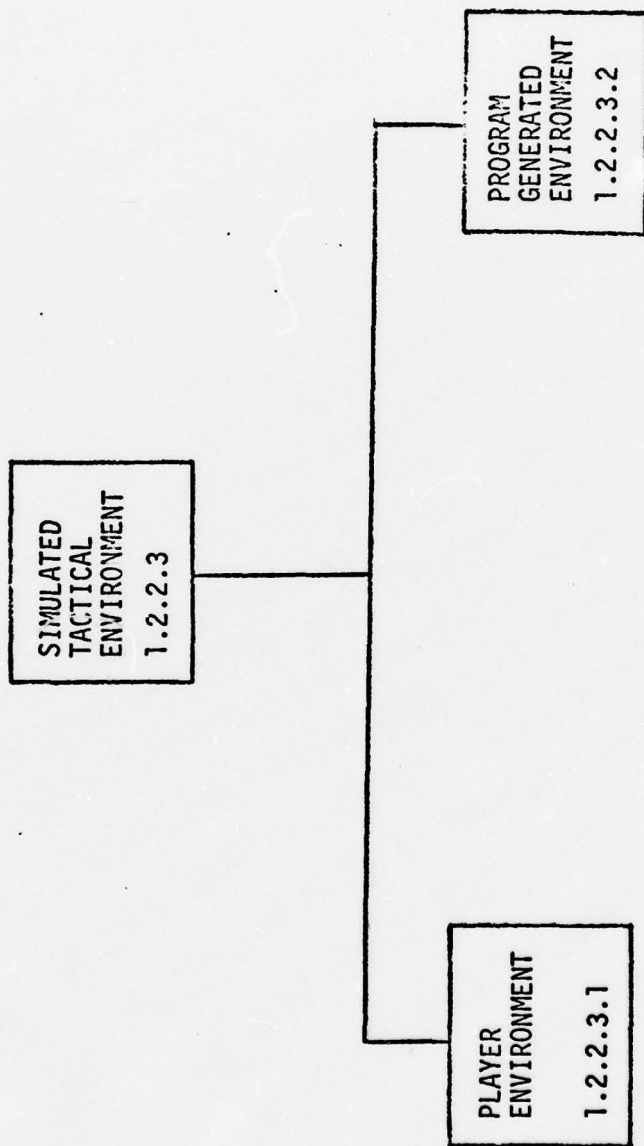


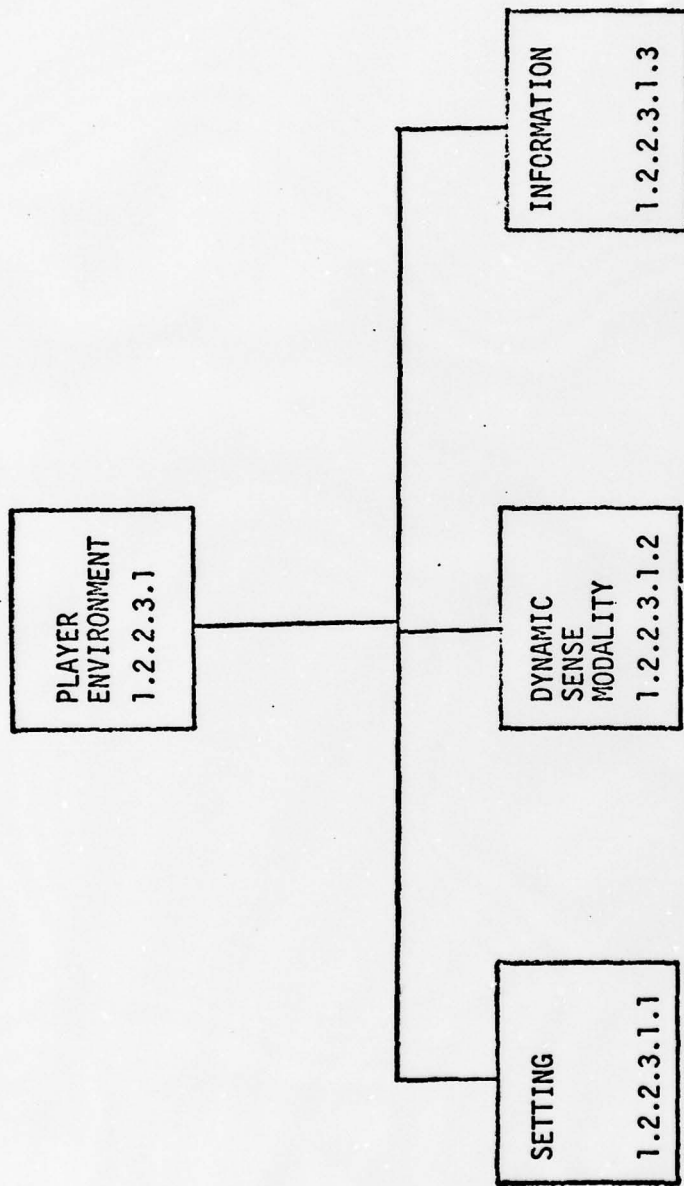


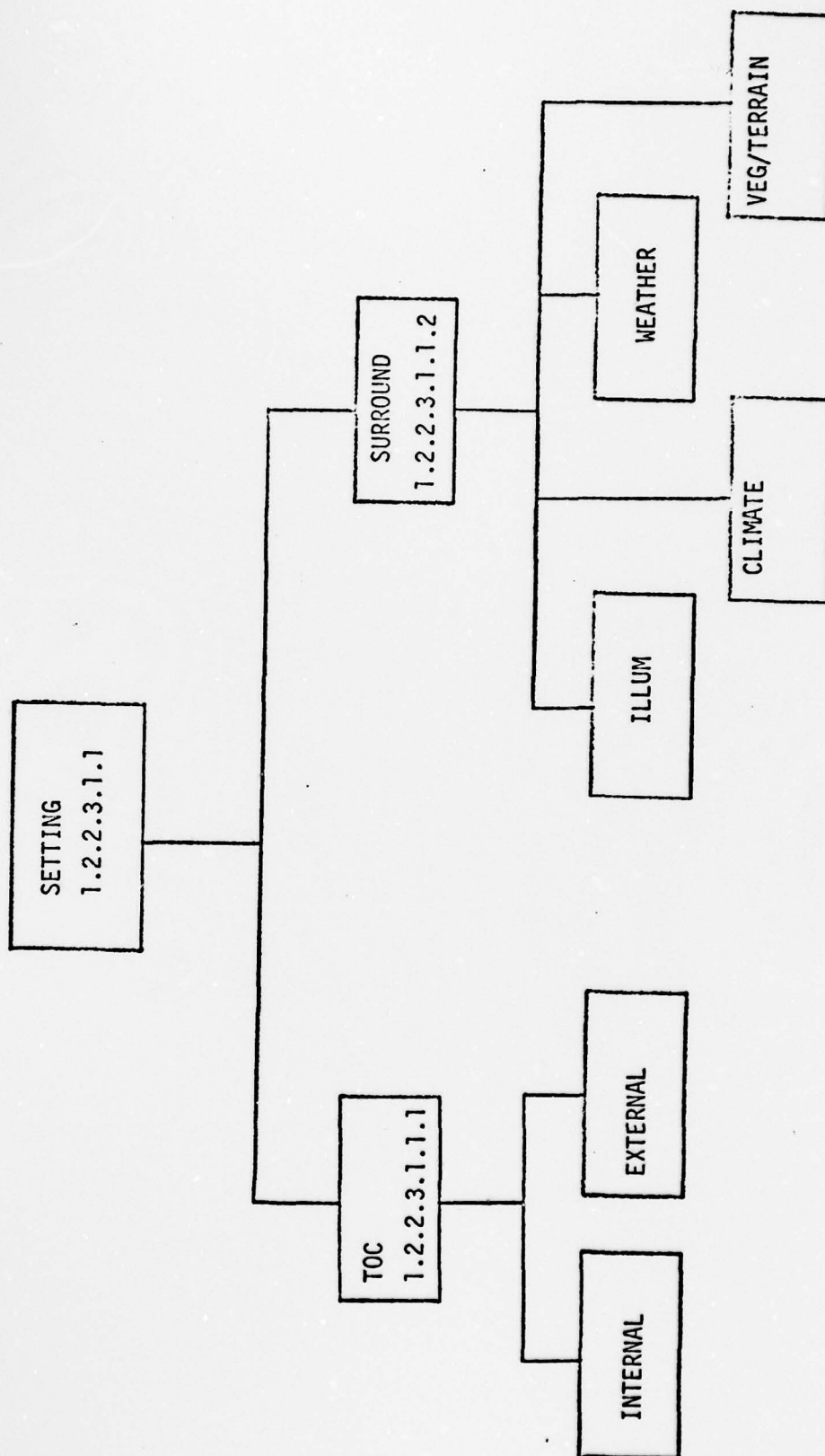


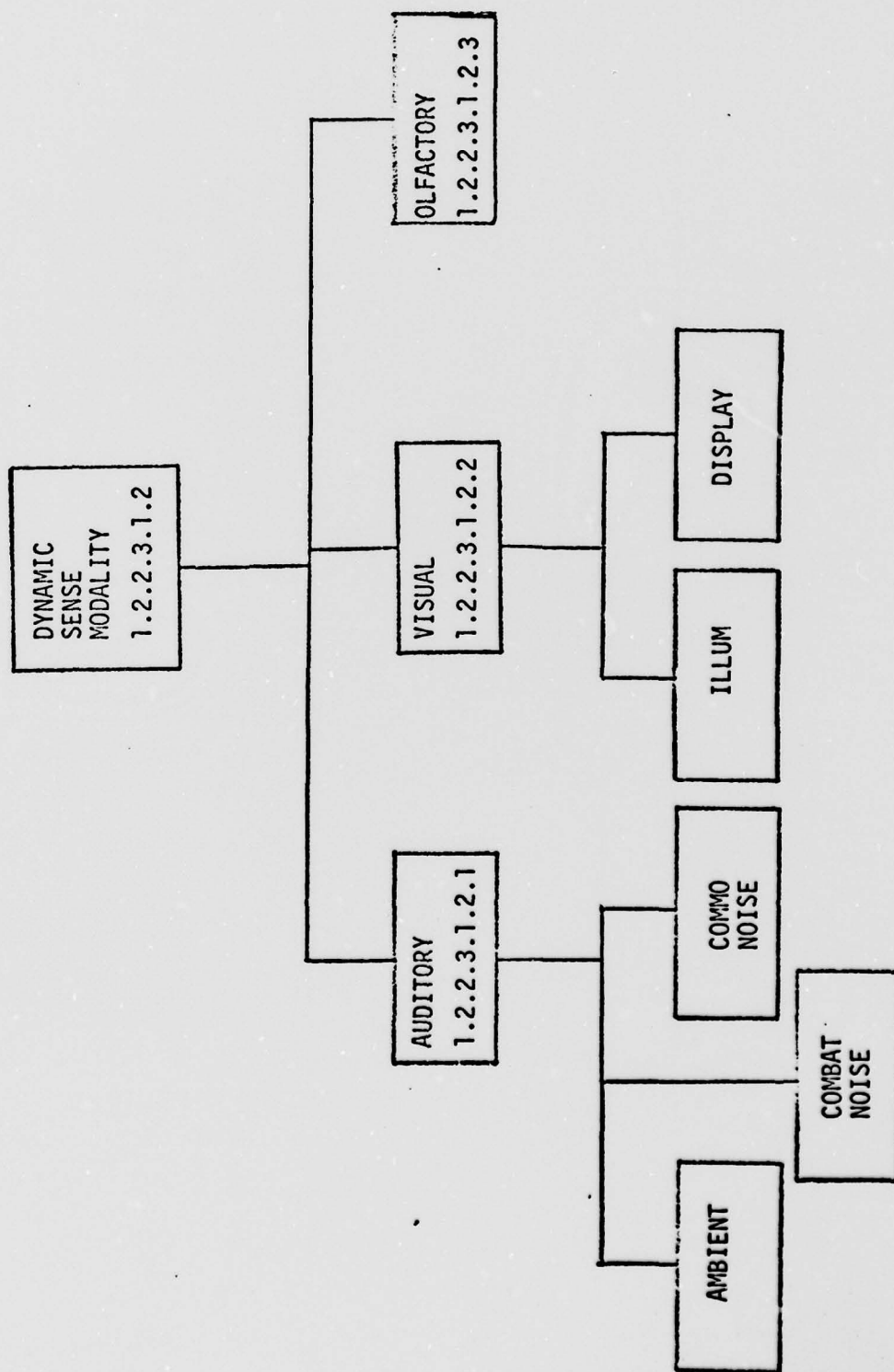


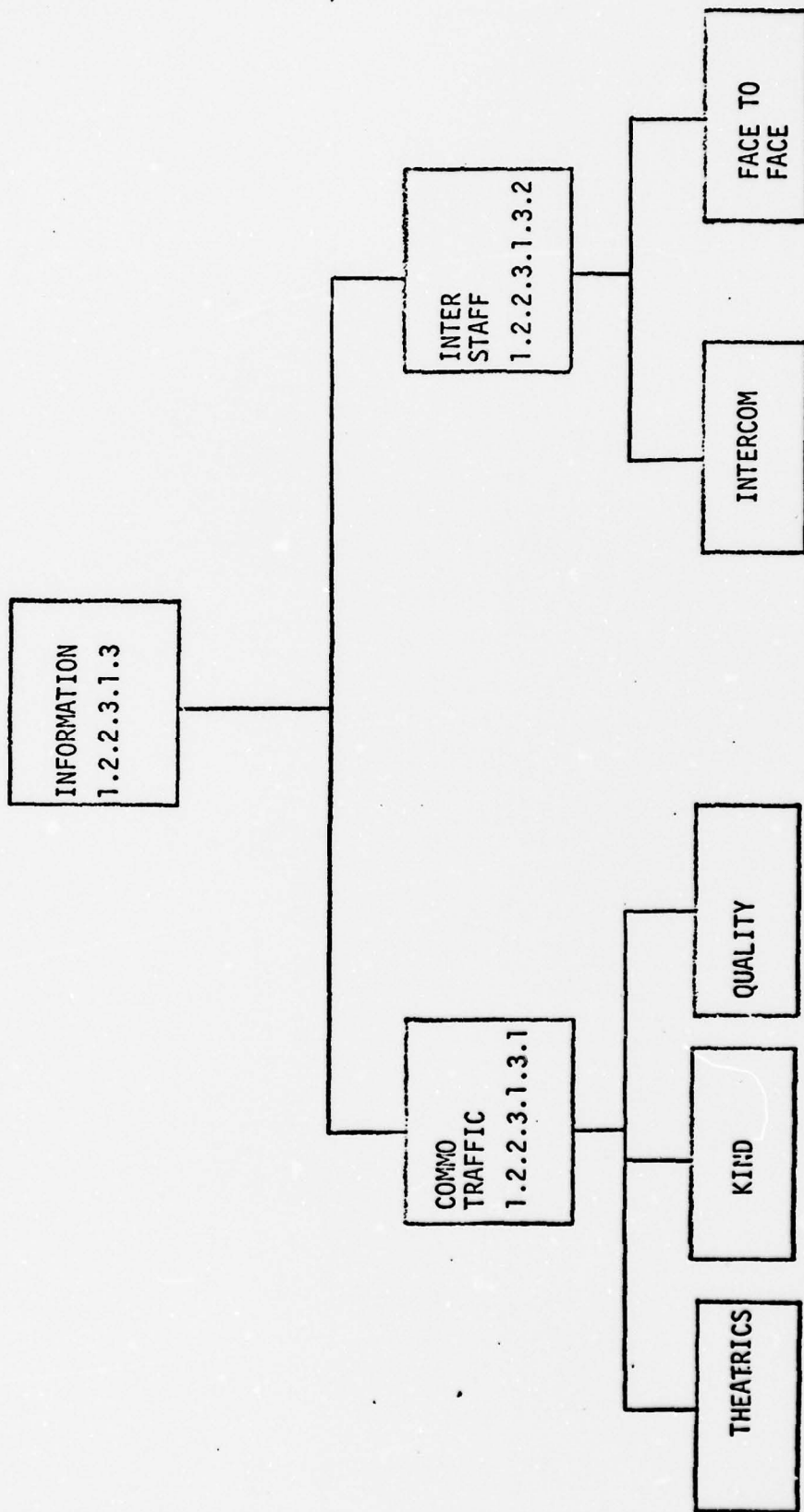








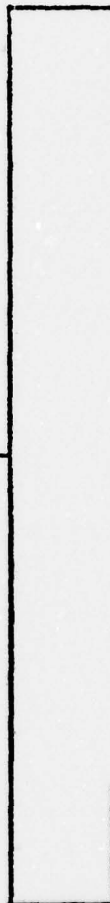


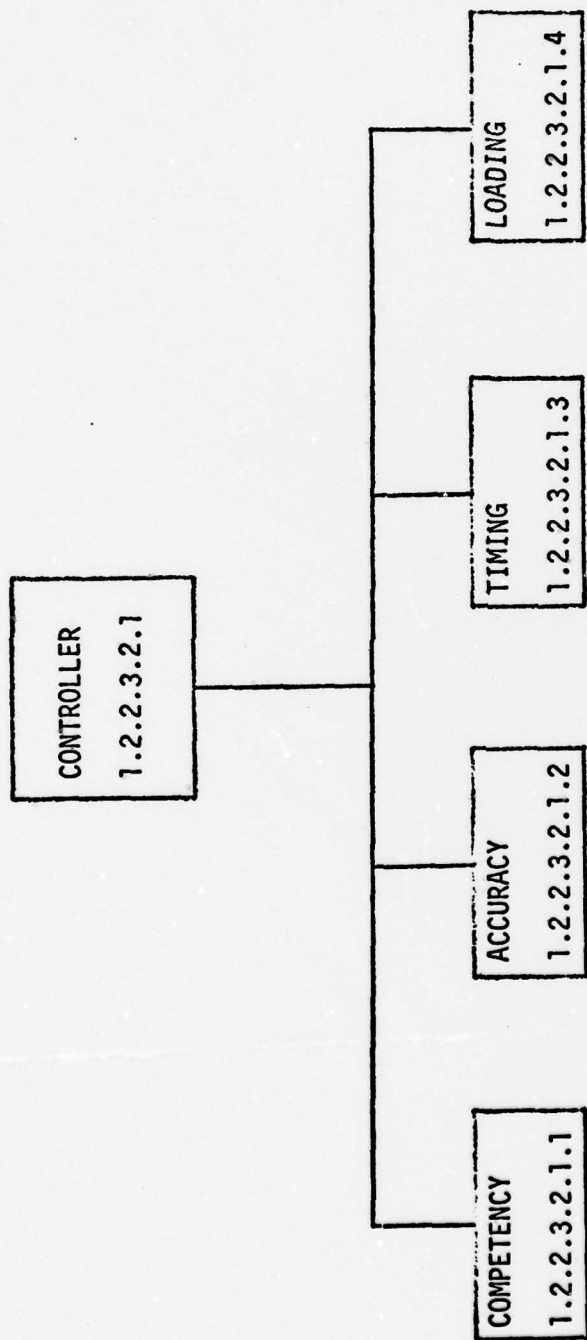


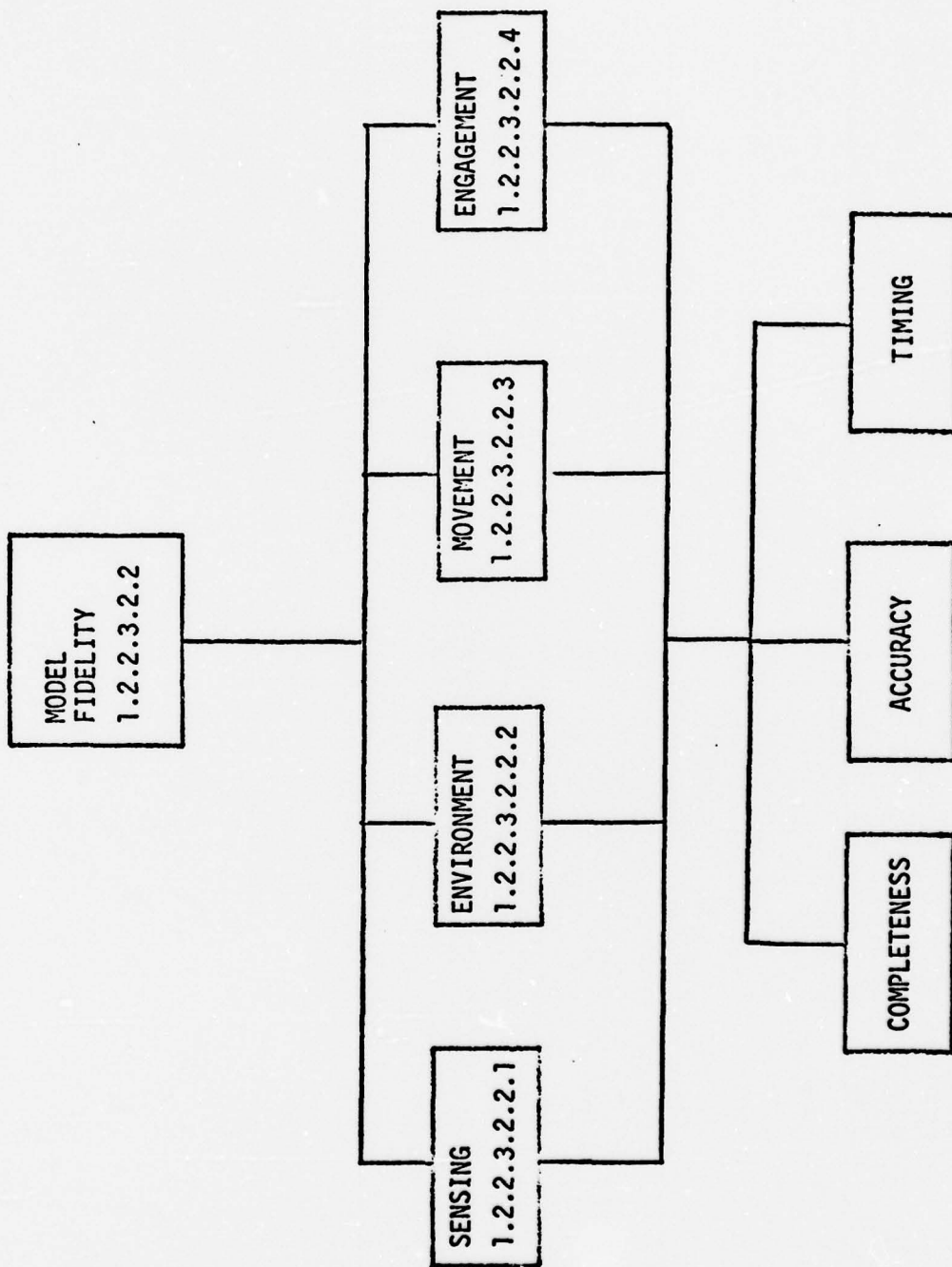
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GENERATED  
ENVIRONMENT  
1.2.2.3.2

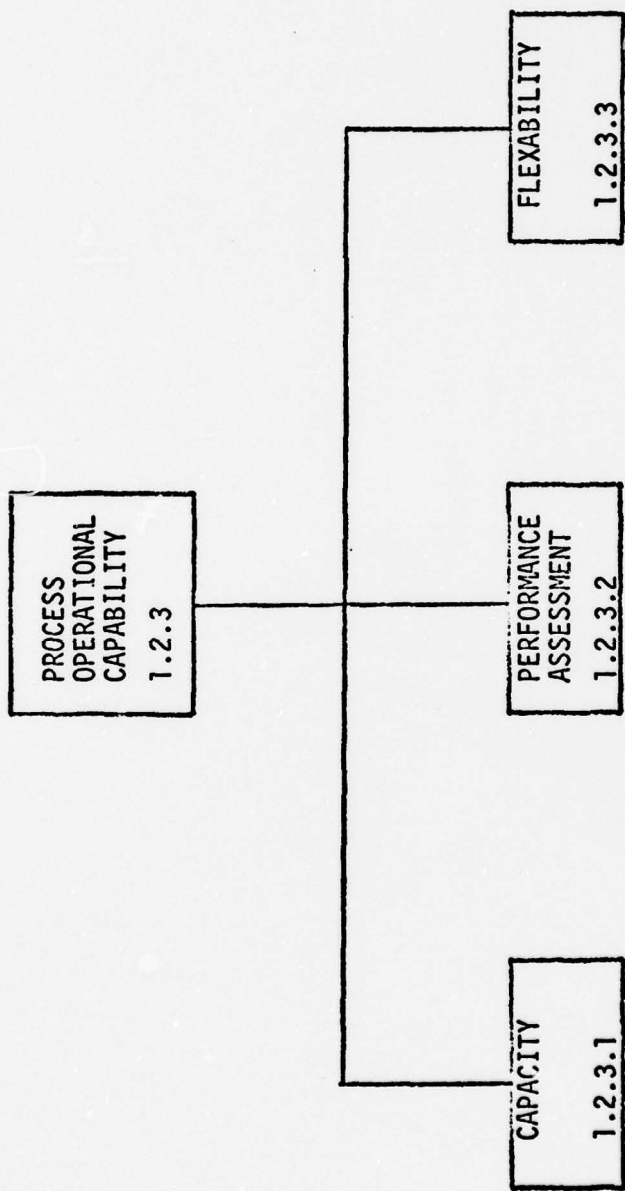
CONTROLLER  
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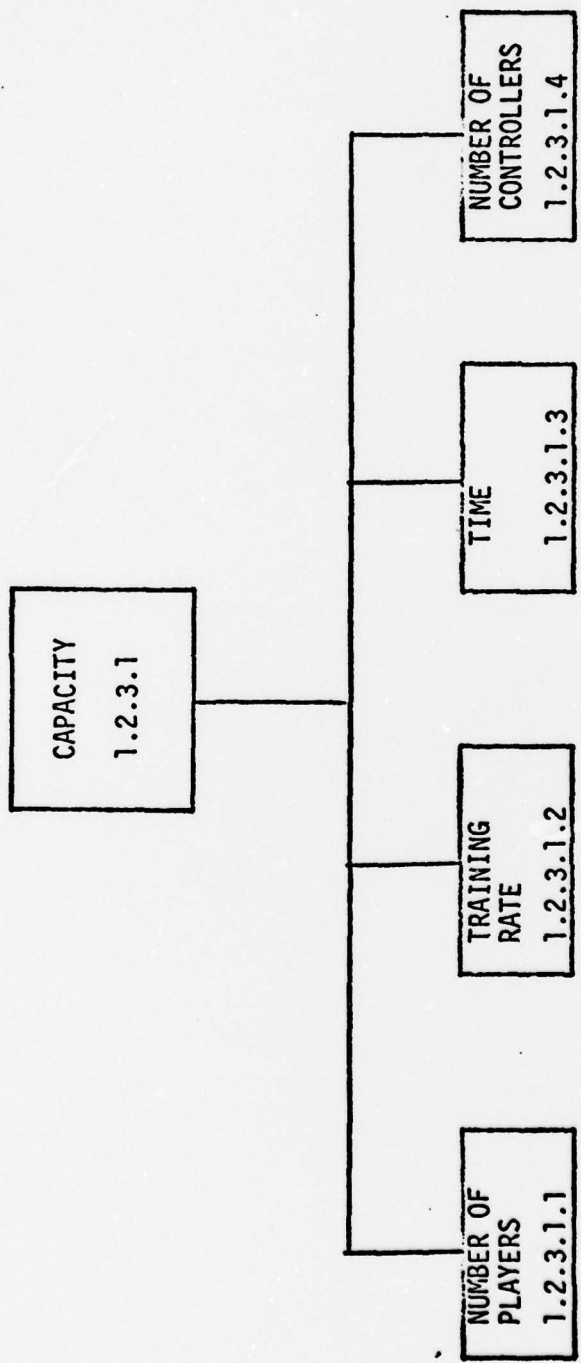
MODEL  
FIDELITY  
1.2.2.3.2.2

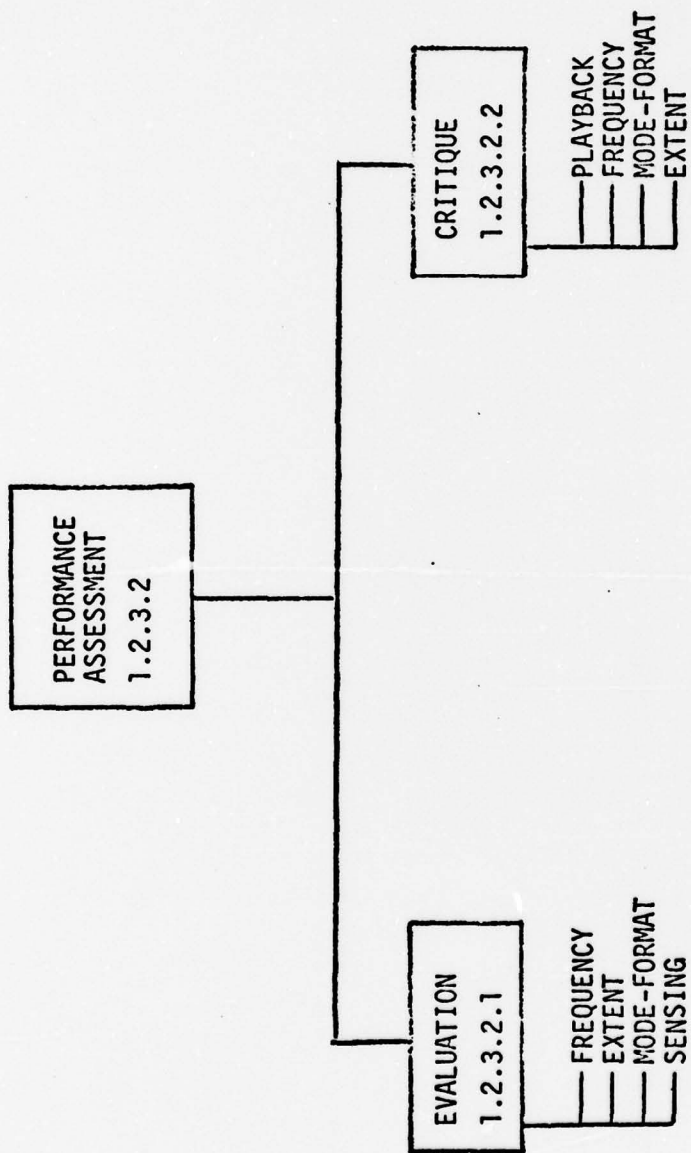


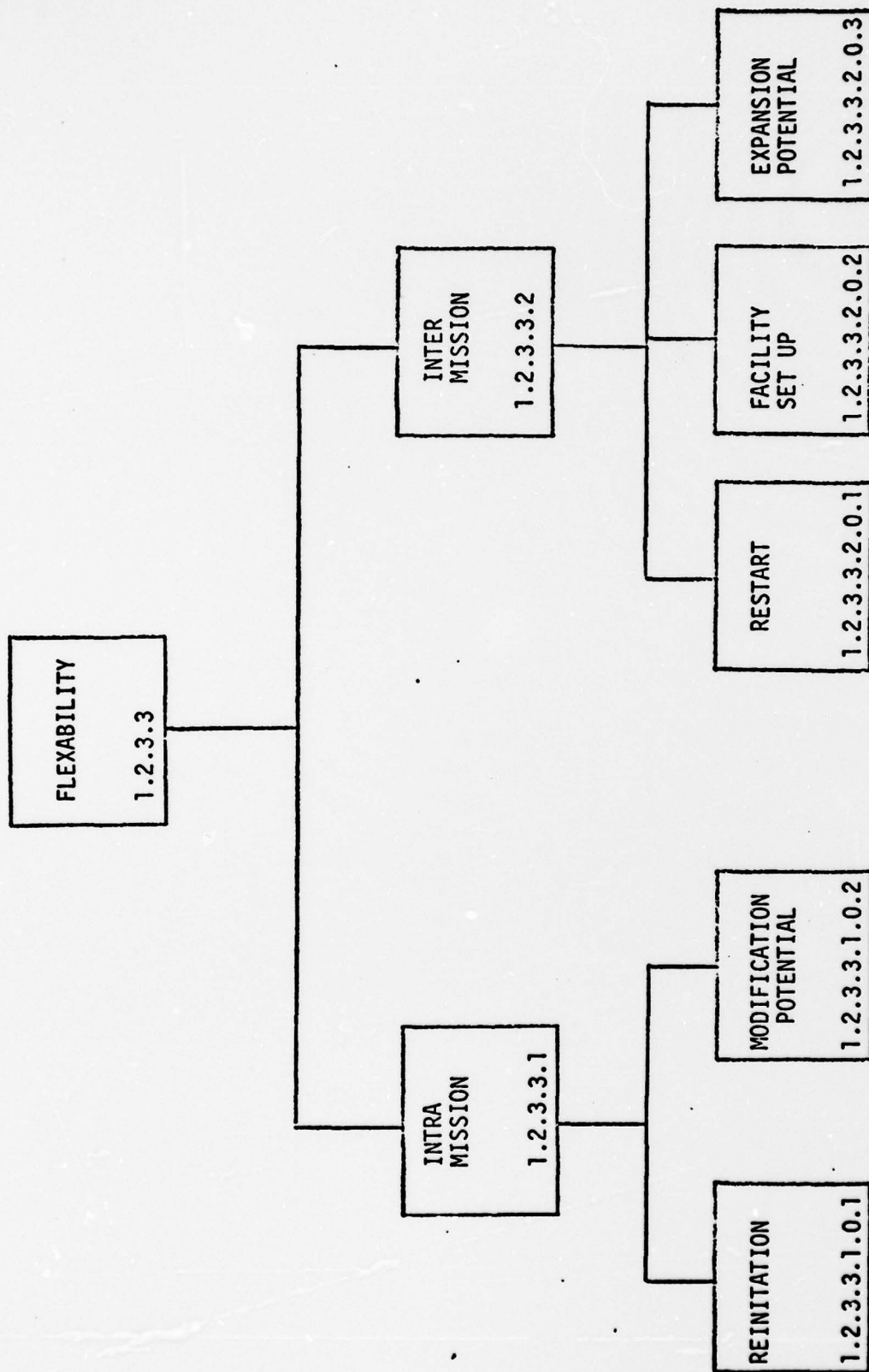


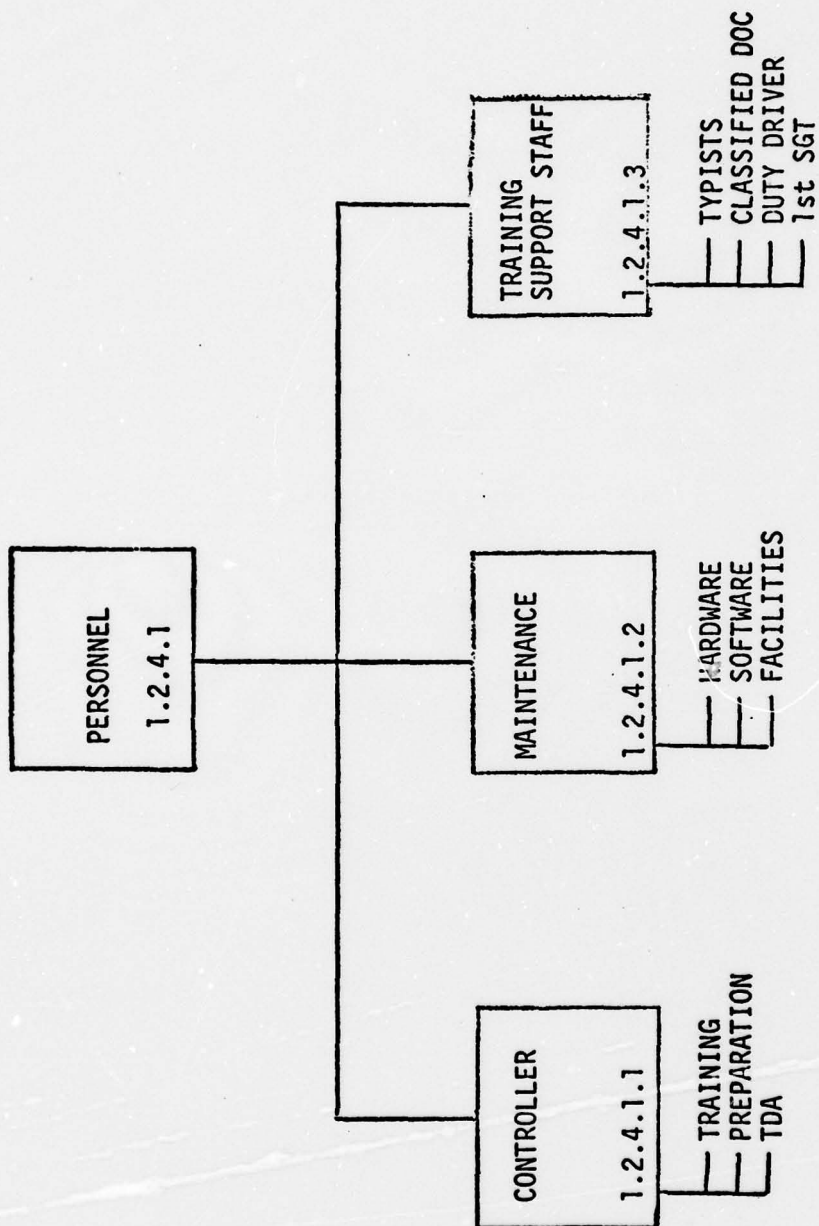


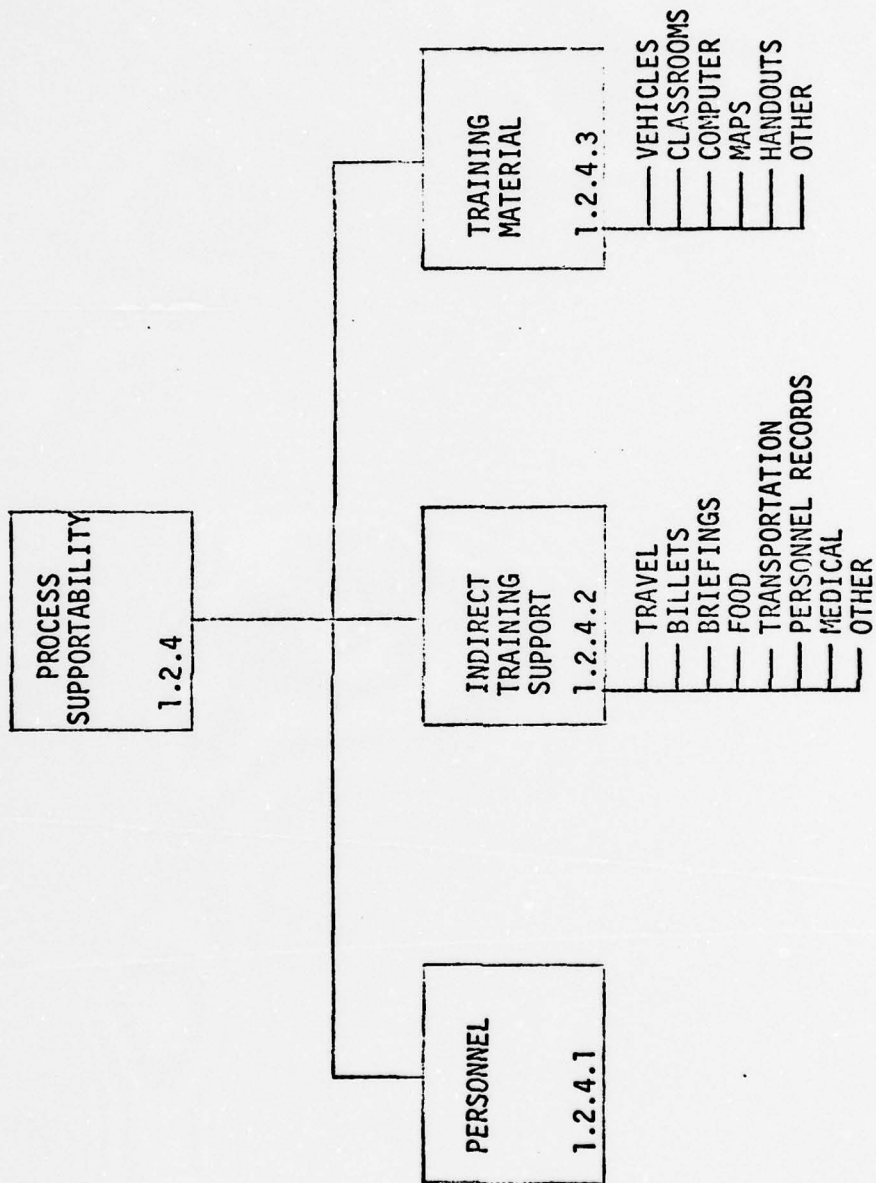












## APPENDIX C

.....  
BLOCK NAMES, DECIMAL BREAKDOWN CODES, DEFINITIONS,  
.....  
MEASURES AND ASSUMPTIONS UNDERLYING EACH DESCRIPTOR  
.....  
IDENTIFIED IN THE TREE.

## 1.0 COST OPERATIONAL EFFECTIVENESS

DEFINITION: A measure of the system operational effectiveness and costs expended in terms of mission objectives for a set of operating conditions and requirements.

MEASURE: The ratio of effectiveness to cost.

ASSUMPTIONS:

- ° The cost and effectiveness are in identical units for each set of conditions.
- ° A criterion exists to make a cost effective decision, e.g., a cost ceiling/effectiveness floor exists and system comparisons will be made in this range.

## 1.1 COST

DEFINITION: Total system cost encompassing R&D costs, initial investment costs and operating costs.

MEASURE: Dollars expended.

ASSUMPTIONS: The systems are compared in the same dollar value (inflated dollars, todays dollars, etc.) and terms (life cycle cost, budget cost, etc.)

### 1.1.1 RESEARCH AND DEVELOPMENT

DEFINITION: Total costs required to bring the system into active inventory.

MEASURE: Dollars expended.

ASSUMPTIONS: The systems are compared in the same dollar value (inflated dollars, todays dollars, etc.) and terms (life cycle cost, budget cost, etc.)

#### 1.1.1.1 HARDWARE

DEFINITION: Includes costs of preliminary research and design studies, development engineering, hardware fabrication of prototype, facilities.

MEASURE: Dollars expended.

ASSUMPTIONS: The systems are compared in the same dollar value (inflated dollars, todays dollars, etc.) and terms (life cycle cost, budget cost, etc.)

#### 1.1.1.2 DEVELOPMENT TESTING

DEFINITION: Costs of R&D testing to include test operations, facilities, instrumentation, support equipment, personnel contract costs, data reduction and analysis, and maintenance.

MEASURE: Dollars expended.

ASSUMPTIONS: The systems are compared in the same dollar value (inflated dollars, todays dollars, etc.) and terms (life cycle cost, budget cost, etc.)

#### 1.1.1.3 SOFTWARE

DEFINITION: Costs include research and design, development, modeling and coding.

MEASURE: Dollars expended.

ASSUMPTIONS: The systems are compared in the same dollar value (inflated dollars, todays dollars, etc.) and terms (life cycle cost, budget cost, etc.)

#### 1.1.1.4 COORDINATION

DEFINITION: Costs of management and technical direction efforts.

MEASURE: Dollars expended.

ASSUMPTIONS: The systems are compared in the same dollar value (inflated dollars, todays dollars, etc.) and terms (life cycle cost, budget cost, etc.)

##### 1.1.1.4.1 SYSTEMS MANAGEMENT

DEFINITION: Supervisory and administrative costs not included in other specified categories.

MEASURE: Dollars expended.

ASSUMPTIONS: The systems are compared in the same dollar value (inflated dollars, todays dollars, etc.) and terms (life cycle cost, budget cost, etc.)

#### 1.1.4.2 TECHNICAL DIRECTION

DEFINITION: Costs of technical consultants, and technical personnel not specified in other categories.

MEASURE: Dollars expended.

ASSUMPTIONS: The systems are compared in the same dollar value (inflated dollars, todays dollars, etc) and terms (life cycle cost, budget cost, etc.)

#### 1.1.2 INITIAL INVESTMENT

DEFINITION: Costs of new construction, equipment (to include initial procurement, spare parts, and consumables<sup>es</sup>), and training, initial transportation and travel.

MEASURE: Dollars expended.

ASSUMPTIONS: The systems are compared in the same dollar value (inflated dollars, todays dollars, etc.) and terms (life cycle cost, budget cost, etc.)

#### 1.1.3 OPERATIONAL COSTS

DEFINITION: Includes costs of equipment and installation maintenance and replacement, supply, training, personnel (pay and allowances), transportation, travel and other services, and other non-direct administrative and support costs.

MEASURE: Dollars expended.

ASSUMPTIONS: The systems are compared in the same dollar value (inflated dollars, todays dollars, etc.) and terms (life cycle cost, budget cost, etc.)

## 1.2 TRAINING EFFECTIVENESS

DEFINITION: A measure of the knowledge and skills imparted to the player by the system.

MEASURE: A rating of the proficiency of the trained man to accomplish his tasks.

ASSUMPTIONS: A set of criteria has been established to evaluate the systems training effectiveness.

### 1.2.1 PROCESS FUNCTIONAL CAPABILITY

DEFINITION: A measure of the instructional process ability to present to the C<sup>2</sup> player both the individual and interactive C<sup>2</sup> knowledges and skills necessary to perform as a member of a battalion staff.

MEASURE: Number of C<sup>2</sup> tasks available compared to number of C<sup>2</sup> tasks required.

ASSUMPTIONS:

- C<sup>2</sup> tasks and skills are known
- Performance criteria for C<sup>2</sup> tasks and skills are specified

#### 1.2.1.1 STIMULUS

DEFINITION: An input to the controller/player that, correctly interpreted, will require him to initiate an overt action, cease his present action, or remain non-active.

MEASURE: An enumeration of the total stimulus events, conditions, and messages.

ASSUMPTIONS: All stimulus events, conditions, and messages that are relevant to this training process can be identified.

##### 1.2.1.1.0.1 CONTENT

DEFINITION: The information contained within the stimulus.

MEASURE: The number of data items contained in the simulation stimulus compared to the data items contained in a tactical stimulus.

ASSUMPTIONS:

- ° All data items for all tactical stimuli can be identified.
- ° The data items can be generated by the training process.

1.2.1.1.0.2 FORM

DEFINITION: The mode by which the stimulus is presented to the controller/player.

MEASURE: The fidelity of the form of presentation of the training stimulus compared to the tactical form.

ASSUMPTION: All possible forms of presentation for each stimulus can be identified.

1.2.1.1.0.3 FORMAT

DEFINITION: Sequencing and patterning of information in exercise stimuli presented to the controller/player

MEASURE: Degree of similarity between training and tactical stimulus messages.

ASSUMPTIONS:

- ° Exercise stimuli will be presented to players in the same format as they would be presented in the combat situation.
- ° Format elements of combat situation stimuli can be identified and defined.

#### 1.2.1.1.0.4 TIMING

DEFINITION: The regulation of the speed of the interactions of the elements in the training process.

MEASURES: The time difference between stimulus presentations in the training process and tactical requirements.

ASSUMPTIONS:

- The time phasing parameters can be identified
- The time phasing parameters can be modeled in the training process
- The differences in player responses between the training process and tactical requirements can be measured

#### 1.2.1.2 RESPONSE

DEFINITION: A controller/player action that is performed as a function of a training stimulus

MEASURE:

- Correctness
- Timeliness

ASSUMPTIONS:

- Controllers will evaluate players actions
- Player performance criteria will be available for controllers to use in their evaluation activities

#### 1.2.1.2.1 INFORMATION AVAILABLE

DEFINITION: There is supplementary data available to the player/controller to that which is contained in the stimulus.

MEASURE:

- ° Determine if the information is available, yes or no.

ASSUMPTIONS:

- ° It is possible to identify all information elements required to support a training mission.
- ° It is possible to include that information in the training model

1.2.1.2.1.1 TIMING

DEFINITION: The regulation of the speed of the interactions of elements in the training process

MEASURES: The time differences between responses in the training process and tactical requirements

ASSUMPTIONS:

- ° The time phasing parameters can be identified
- ° The time phasing parameters can be modeled in the training process
- ° The differences in player responses between the training process and tactical requirements can be measured.

1.2.1.2.1.2 FORM

DEFINITION: The mode by which information is requested.

MEASURE: The number of data sources in the training process compared to those in the tactical system.

ASSUMPTION: All possible information sources available to the controller/player can be identified

#### 1.2.1.2.1.3 PLACE

DEFINITION: A simulated location that the player can access for the purpose of acquiring/distributing additional information.

MEASURE: Number of training locations provided compared to tactical locations.

ASSUMPTIONS:

- ° Players are required to seek out information in the exercise from the same sources as they would in the tactical situation.
- ° Combat information sources can be identified, inventoried, and modeled in the training process.

#### 1.2.1.2.1.4 FORMAT

DEFINITION: Sequencing and patterning of the controller/player responses in an effort to obtain more information.

MEASURE: Degree of similarity between training and tactical players' responses to obtain additional information.

ASSUMPTIONS:

- ° The formats of tactical situation information seeking behavior can be identified and defined.
- ° Controllers/players are expected to follow certain prescribed sequences and patterns to obtain additional information to enlarge upon tactical stimuli.

#### 1.2.1.2.1.5 CONTENT

DEFINITION: The data contained within the request for information.

MEASURE: The number of data items contained in the simulation stimulus compared to the data items contained in a tactical stimulus.

ASSUMPTION:

- ° It is possible to identify all data and sources required to support a training exercise
- ° It is possible to include the data and sources in the model

#### 1.2.1.2.2 IMPLEMENT

DEFINITION: The input action performed by either the controller or player as a function of the stimulus.

MEASURE:

- ° Did the player perform the action
- ° The quality of the action performed

ASSUMPTIONS:

- ° The controller will perform as required
- ° The resources necessary to support the implementation actions will be available

#### 1.2.1.2.2.1 FORM

DEFINITION: The mode by which the controller/player implements his response to a stimulus.

MEASURE: The number of data sources in the training process compared to those in the tactical system.

**ASSUMPTION:**

- ° The modes of response to a stimulus in the tactical situation can be identified.
- ° The modes of response can be modeled in the training process.

**1.2.1.2.2.2 AGENT**

**DEFINITION:** The means (units, weapons, fire support, etc.) provided to the controller/player for carrying out exercise combat action.

**MEASURES:** Exercise agents provided vs tactical situation provided agents.

**ASSUMPTIONS:**

- ° Players will be required to utilize all military resources available in order to carry out C<sup>2</sup> actions during training exercises.
- ° All tactical resources manually provided will be available in the training model.

**1.2.1.2.2.3 FORMAT**

**DEFINITION:** The sequencing and patterning of controller/player response actions.

**MEASURE:** Degree of similarity between training and tactical players' implementation responses.

**ASSUMPTIONS:**

- ° The formats of tactical responses can be identified and defined
- ° Controller/players are expected to follow certain prescribed sequences and patterns to respond to stimuli.

#### 1.2.1.2.2.4 CONTENT

DEFINITION: The data elements contained within the response

MEASURE: A comparison of the data elements contained in the training response to those contained in a tactical response.

ASSUMPTIONS:

- ° It is possible to identify all data elements of tactical stimulus response.
- ° It is possible to model response oriented data elements.

#### 1.2.1.2.2.5 TIMING

DEFINITION: The regulation of the speed of the interactions of the elements in the training process.

MEASURE: The time differences between implementation activities in the training process and tactical conditions.

ASSUMPTIONS:

- ° The time phasing parameters can be identified
- ° The time phasing parameters can be modeled in the training process
- ° The differences in player responses between the training process and tactical requirements can be measured

#### 1.2.2 PROCESS SITUATIONAL CAPABILITY

DEFINITION: The training process ability to simulate all tactical situations within which the controllers/players must perform their C<sup>2</sup> staff tasks.

MEASURES: The number of simulated tactical conditions, operations, and environments compared to the number required

ASSUMPTIONS: The tactical situations to be simulated for the training exercise can be identified and modeled.

#### 1.2.2.1 SIMULATED TACTICAL FORCES

DEFINITION: The representation of friendly and aggressor force capabilities, limitations, organization and deployment.

MEASURE: The number of friendly and aggressor force capabilities, limitations, organizations, and deployment factors simulated vs those occurring in the tactical situation.

ASSUMPTIONS: Required friendly and aggressor force capability, limitation, organization, and deployment can be identified.

##### 1.2.2.1.1 FRIENDLY FORCES

DEFINITION: The Friendly Forces resources and resource dispositions required in a training exercise.

MEASURE: The resources and resource dispositions simulated compared to those required for a training exercise.

ASSUMPTION:

- ° All the resources required to conduct a training exercise and the disposition of those resources will be identified.
- ° The training process is able to simulate these requirements.

#### 1.2.2.1.1.1 RESOURCES

DEFINITION: The representation of the following resource attributes of the friendly forces: (a) psychological, training, and physiological states; (b) type units available or employed; (c) weapon types and capabilities; (d) number of troops available or deployed; and (e) other factors to be identified later.

MEASURE: The number of friendly force attributes represented in the model vs those occurring in the tactical situation.

#### ASSUMPTION:

- ° All required friendly force resource attributes can be identified and defined.
- ° Maximum number of friendly force resource attributes will be represented in the tactical model.

#### 1.2.2.1.1.2 DISPOSITION

DEFINITION: The representation of the following disposition attributes of the friendly forces: (a) interval or distance between units; (b) applicable tactical doctrine; (c) force task/team organization; and (d) accuracy of force locations.

#### MEASURE:

- ° Number of friendly force disposition attributes represented vs those required in the tactical situation.
- ° Judgement of the accuracy of representation of friendly force disposition attributes.

ASSUMPTION:

- ° The disposition attributes of friendly forces can be identified and defined.
- ° The complete set of friendly force disposition attributes will be represented in the tactical model.

1.2.2.1.2 AGGRESSOR FORCES

DEFINITION: The aggressor forces resources and resource dispositions required in a training exercise.

MEASURE: The resources and resource dispositions simulated compared to those required for a training exercise.

ASSUMPTION:

- ° All the aggressor forces required to conduct a training exercise and the disposition of those resources will be identified.
- ° The training process is able to simulate these requirements.

1.2.2.1.2.1 RESOURCES

DEFINITION: The representation of the following resources attributes of the aggressor forces: (a) psychological training, and physiological states; (b) type units available or employed; (c) weapon types and capabilities; (d) number of troops available or deployed; and, (e) other factors to be identified later.

MEASURE: The number of aggressor force attributes represented in the model vs those occurring in the tactical situation.

ASSUMPTION:

- ° All required aggressor force resource attributes can be identified and defined.
- ° The maximum number of aggressor force resource attributes will be represented in the tactical model.

1.2.2.1.2.2 DISPOSITION

DEFINITION: The representation of the following disposition attributes of the aggressor forces: (a) interval or distance between units; (b) applicable tactical doctrine; (c) force task/team organization; and (d) accuracy of force location.

MEASURE:

- ° The number of aggressor force disposition attributes represented vs those required in the tactical situation.
- ° Judgement of the accuracy of representation of aggressor force disposition attributes.

ASSUMPTIONS:

- ° The disposition of attributes of aggressor forces can be identified and defined.
- ° The maximum number of aggressor force disposition attributes will be represented in the tactical model.

1.2.2.2 SIMULATED TACTICAL OPERATIONS

DEFINITION: The modeling of mission types and profiles relevant to battalion staff C<sup>2</sup>.

MEASURES: The number of mission types and profiles that can be simulated compared to tactical situations.

ASSUMPTIONS: Mission types and respective profiles relevant to the training mission can be identified and modeled for the training process.

#### 1.2.2.2.1 MISSION TYPE

DEFINITION: A simulated tactical operation may contain one or more of the following types of missions: (1) defense; (2) attack; (3) retrograde.

MEASURE: Compare the types available in the training process with the number in tactical situations.

ASSUMPTIONS: Each mission type can be identified and modeled in the training process.

#### 1.2.2.2.1.2 ATTACK

DEFINITION: A specific military tactic designed to guard against attack.

MEASURE:

- The number of defense types provided by the process compared to the possible defense types in a tactical situation.
- The number of tactical defense errors during a training exercise.

ASSUMPTIONS:

- The defense types for tactical situations can be identified.
- The required defense types can be modeled by the process.

#### 1.2.2.2.1.1 DEFENSE

DEFINITION: A specific military tactic designed to guard against attack.

MEASURE:

- ° The number of defense types provided by the process compared to the possible defense types in a tactical situation.
- ° The number of tactical defense errors during a training exercise.

ASSUMPTIONS:

- ° The defense types for tactical situations can be identified.
- ° The required defense types can be modeled by the process.
- ° The defense types will include Area Defense, Riverline Defense, and Passage of lines.
- ° Error data can be accumulated to support reliability figures.

#### 1.2.2.2.1.2 ATTACK

DEFINITION: A specific military tactic designed to take the offensive.

MEASURE:

- ° The number of attack types provided by the process compared to the attack types required.
- ° The number of attack errors during a training exercise.

ASSUMPTIONS:

- ° The attack types required will be identified.
- ° The required attack types can be modeled by the process.
- ° The attack types will include coordinated, pursuit, explaytation and passage of lines.

- Error data can be accumulated to support reliability figures.

#### 1.2.2.2.1.3 RETROGRADE

DEFINITION: A Specific military tactic designed to withdraw from a disadvantageous position.

MEASURE:

- The number of Retrograde tactics provided by the process compared to the retrograde tactics required.
- The number of errors during a training exercise.

ASSUMPTIONS:

- The Retrograde types required will be identified.
- The required retrograde types can be modeled by the process.
- The retrograde types will include voluntary withdraw, involuntary withdraw, delay, retire, relief, and passage of lines.
- Error data can be accumulated to support reliability figures.

#### 1.2.2.2.2 MISSION PROFILES

DEFINITION: A mission profile is composed of a finite number of events, a preferred and an acceptable sequence of those events, and a preferred and an acceptable timing of the occurrence of the events.

MEASURE: The number of events that meet the number, sequence, and timing criteria within each mission profile compared to the number required.

ASSUMPTIONS:

- The mission profile criteria for number, sequence, and timing of events is known.

- ° The mission profile events can be modeled.

#### 1.2.2.2.2.1 NUMBER

DEFINITION: The sum of mission related events that comprise a mission profile.

MEASURE: The number of events present in the training process compared to the number required by the tactical mission profile.

ASSUMPTIONS: The mission related events can be identified and modeled for the training process.

#### 1.2.2.2.2.2 TIMING

DEFINITION: Clock scheduling of the presentation of events in the mission profile.

MEASURE: Time each event of interest occurs compared to tactical requirements.

ASSUMPTIONS: The timing of events in a mission profile can be determined and modeled for the training process.

#### 1.2.2.2.2.3 SEQUENCE

DEFINITION: The order of presentation of  $C^2$  events in the mission profile.

MEASURE: The number of events that can be presented in the training process in an acceptable sequence.

ASSUMPTIONS: The presentation sequence of  $C^2$  events can be identified and modeled for the training process.

#### 1.2.2.3 SIMULATED TACTICAL ENVIRONMENT

DEFINITION: The modeling of a tactical environment for the training process.

MEASURE:

- ° The number of environmental situations in the model compared to the number of tactical situations.
- ° Perception of tactical environment realism by the player.

ASSUMPTIONS: The environmental situations that impact staff c<sup>2</sup> activities can be identified and modeled.

#### 1.2.2.3.1 PLAYER ENVIRONMENT

DEFINITION: The players perception of the realism of the simulated command post.

MEASURES: Subjective evaluation (rating) of overall realism of exercise tactical environment.

ASSUMPTIONS: A realistic training environment enhances training effectiveness.

#### 1.2.2.3.1.1 SETTING

DEFINITION: The extent to which the static player station environment resembles an actual command post and its terrain site.

MEASURE: Player subjective evaluation (rating) of realism of exercise command post and its setting.

ASSUMPTIONS:

- ° The Exercise command post will resemble a tactical command post in an environmental setting.
- ° Training realism enhances training effectiveness.

1.2.2.3.1.1.1 TOC (Tactical Operations Center)

DEFINITION: The extent to which the player command post (CP) work station resembles an actual command post in physical appearances and dimensions. It includes the following factors:

- ° Internal. The extent the interior of the player station resembles an actual CP in terms of physical dimensions, appearance, and equipment.
- ° External. The extent the exterior of the player station resembles the exterior of an actual CP in terms of appearance, dimensions, and access.

MEASURE: Player subjective evaluation (rating) of realism of the CP work stations and CP appearance.

ASSUMPTIONS:

- ° The exercise command post will resemble the exterior and interior of a tactical command post.
- ° Training realism enhances training effectiveness.

1.2.2.3.1.1.2 SURROUND

DEFINITION: The extent to which physical setting around the exterior of the player station (CP) resembles the terrain, vegetation, climatic conditions, weather conditions, and illumination levels associated with

the area of operations. These factors may include the following factors.

- Illumination levels (day/night cycle)
- Climate (desert, tropical, etc.)
- Weather (clear, overcast, humidity, heat, cold, rain, snow, etc.)
- Vegetation (trees, lack of trees, grass, etc.)
- Terrain (desert, plains, mountains, river bank, etc.)

MEASURE: Subjective evaluation (rating) of realism of terrain setting of the command post.

ASSUMPTIONS:

- The player CP will be placed in a realistic terrain setting.
- "Experts" are available for subjective rating

1.2.2.3.1.2 DYNAMIC SENSE MODALITY STIMULATION

DEFINITION: The extent to which visual, auditory and other sensory events cause the player to feel he is in a tactical command post during the course of the exercise.

MEASURE: Subjective evaluation (rating) of realism of sensory events (sounds, sight, etc.) occurring during the training exercise.

ASSUMPTIONS:

- Visual, auditory, and other sensory events will be utilized to enhance the effectiveness of training exercises.
- "Experts" are available for subjective evaluation.

#### 1.2.2.3.1.2.1 AUDITORY EVENTS

DEFINITION: The extent to which situational auditory events cause the player to feel he is in a tactical battalion CP. Such events can be -- assuming these events are orchestrated to the situation: (a) ambient noise which includes background generator noise, engine noise, and CP equipment noise (e.g., FM "hiss," TTY & RATTs noises, field phone ring, etc.); (b) combat noise which includes outgoing and incoming artillery fire, near and distant small arms fire, near and distant explosions, vehicle traffic, etc.; (c) communications noise which includes communication system noise addressed to the ears of the player during use of the communication equipment (e.g. static, cross-talk, FM hiss, TTY chatter, telephone ring, jamming, interruptions, etc.).

MEASURE: 'EXPERT' subjective evaluation (rating) of realism of auditory events during the exercise.

#### ASSUMPTIONS:

- ° Auditory events will be utilized to enhance exercise realism.
- ° 'EXPERTS' are available for subjective evaluation.

#### 1.2.2.3.1.2.2 VISUAL EVENTS

DEFINITION: The extent to which situational generated visual events cause the player to feel he is in a tactical bn CP. Such events can be: (a) illumination to connote day-night cycle, to present flash to simulate nearby weapon strikes and effects, to suggest fire in CP area, etc.; (b) displays to include use of military maps, overlays, and charts to

facilitate conduct of operation, display event changes, display passage of time, etc.

MEASURE: 'EXPERT' subjective evaluation (rating) of realism of visual events utilized during an exercise.

ASSUMPTIONS:

- ° Visual events will be utilized to enhance exercise realism.
- ° 'EXPERTS' will be available for subjective evaluation.

#### 1.2.2.3.1.2.3 OLFACTORY EVENTS

DEFINITION: The extent to which the sense of smell contributes to the player's feeling that he is in a tactical CP. For example, in a CP vehicle, exhaust fumes could be an olfactory event.

MEASURE: 'EXPERT' subjective evaluation (rating) of realism of olfactory events utilized during an exercise.

ASSUMPTIONS: 'EXPERTS' will be available for subjective evaluation.

#### 1.2.2.3.1.3 INFORMATION

DEFINITION: The extent to which information exchange events between players and controllers and the nature of these events cause the player to feel he is in a tactical bn CP.

MEASURE: 'EXPERT' subjective evaluation (rating) of realism of information events experienced during the exercise.

ASSUMPTIONS:

- ° Information events will be utilized to enhance exercise realism
- ° 'EXPERTS' will be available for subjective evaluation.

#### 1.2.2.3.1.3.1 COMMUNICATIONS TRAFFIC

DEFINITION: The extent to which the nature and quality of communications traffic between player and controller cause the player to feel he is in a realistic tactical bn CP. This includes such factors as: (a) Theatrics or dramatic elements introduced into communications process by the controller; (b) kind of communications which includes the types of messages between controllers and player (e.g. operations orders, status messages, spot reports, etc.); (c) quality of communications which pertains to quality and completeness of information received.

MEASURE: 'EXPERT' subjective evaluation (rating) of realism of communication traffic events during exercise.

#### ASSUMPTIONS:

- ° Communication traffic event realism will be utilized to enhance exercise realism.
- ° 'EXPERTS' will be available for subjective evaluation.

#### 1.2.2.3.1.3.2 INTRA-STAFF COMMUNICATION

DEFINITION: The extent to which the CP environment permits the player staff to communicate with each other in a real-life manner to impact the feeling they are in a tactical bn CP. This includes such factors as: (a) intercom communications on the extent to which the exercise CP provides intercom facilities similar to a tactical CP to permit the staff sections to exchange information; (b) face-to-face the extent to which the CP configuration permits face-to-face player communication in a manner similar to actual tactical bn CPs.

MEASURE: 'EXPERT' subjective evaluation (rating) of the realism of the intra-staff communication features of the battalion (CP).

ASSUMPTIONS:

- ° Intra-staff communication factors will be utilized to enhance exercise realism.
- ° 'EXPERTS' will be available for subjective evaluation.

1.2.2.3.2 PROGRAM GENERATED ENVIRONMENT

DEFINITION: Program generated fidelity of the simulator to tactical conditions as prescribed in the training exercise.

MEASURE: Expert judgement of the fidelity of the entire training exercise to tactical conditions.

ASSUMPTIONS: Qualified personnel will be available to render "expert" judgements on the fidelity of the program generated environment to the training exercise.

1.2.2.3.2.1 CONTROLLER

DEFINITION: An operator who is responsible for maintaining a realistic input/output flow of stimuli and responses in a training exercise.

MEASURE: Number of controller errors of commission and omission during an exercise.

ASSUMPTIONS:

- ° All controller tasks, function, and decision requirements can be identified and defined.
- ° The flow characteristics of scenario events can be identified and modelled.
- ° The controller has complete control over all exercise events.

#### 1.2.2.3.2.1.1 COMPETENCY

DEFINITION: The controller's capability to perform correct tactical actions and reactions appropriate to the training mission.

MEASURE: Passing score on an end-of-course examination for controller personnel.

ASSUMPTIONS:

- ° All necessary tactics appropriate to the training mission can be identified.
- ° The necessary tactics can and will be taught to the controller.
- ° The controller will pass an examination on tactics prior to assuming a controller's position for OTI.

#### 1.2.2.3.2.1.2 ACCURACY

DEFINITION: The ability of the controller to conduct the exercise in an error free manner.

MEASURE: The number and types of errors per training exercise.

ASSUMPTIONS:

- ° The controller is required to conduct an exercise without input or output error.
- ° Possible errors can be identified.
- ° The controller's man machine interface has been subjected to a thorough human factors engineering evaluation resulting in corrective actions as required.

#### 1.2.2.3.2.1.3 TIMING

DEFINITION: The ability of the controller to maintain realistic timing sequences.

MEASURE: The number of controller timing errors affecting simulated tactical timing sequences.

ASSUMPTIONS: Tactical timing sequences can be identified and modeled.

#### 1.2.2.3.2.1.4 LOADING

DEFINITION: The ability of the controller to effectively manage work loads associated with the conduct of tactical exercises.

MEASURE: Failure of the controller to process and treat exercise events as number of events increase in frequency, number, and complexity.

ASSUMPTIONS:

- There will be high controller loading incidents during exercises.
- The controller's man-machine interface will be subjected to a human factors engineering analysis based on a comprehensive task and skills analysis for each controller position.

#### 1.2.2.3.2.2 MODEL FIDELITY

DEFINITION: The physical portrayal of the environment, movement, sensing, and engagement activities in a training situation that impacts player performance on C<sup>2</sup> functions.

MEASURE: Subjective rating of the fidelity of the training model to tactical conditions.

ASSUMPTIONS: 'EXPERT' raters are available to render a judgement of the model fidelity to the tactical conditions.

1.2.2.3.2.2.1 SENSING

DEFINITION: Line-of-sight target detection.

MEASURE: The probability that a visible target will be detected.

ASSUMPTIONS: The target detection parameters relevant to a training mission can be identified and modeled.

1.2.2.3.2.2.2 ENVIRONMENT

DEFINITION: All physical characteristics associated with a training exercise that impact a player's perception of the exercise.

MEASURE:

- ° Percentage of the environmental conditions that can be modeled.
- ° Controller judgement of the authenticity of model generated environmental conditions.

ASSUMPTIONS:

- ° The physical characteristics can be identified.
- ° Those characteristics can be modeled, to some degree of tactical fidelity, in the player environment.

1.2.2.3.2.2.3 MOVEMENT

DEFINITION: The change of location of both friendly and aggressor forces and equipment during an exercise.

MEASURE: The time required to move from one location to another.

ASSUMPTIONS: The components of movement for all forces and equipment taking into account the effects of environment can be identified and modeled.

#### 1.2.2.3.2.2.4 ENGAGEMENT

DEFINITION: The representation of those friendly and enemy force combat actions and counter-actions and events necessary to represent battalion tactical operations.

MEASURE: Representation of events typifying combat actions between opposing forces at battalion level in comparison to total number required, to represent battalion level combat.

ASSUMPTIONS:

- ° Combat actions and counteractions include weapons, weapon effects, unit locations, barriers and their effects, tactics, casualty assessment, and other representations of combat action.

- ° The model contains representation of higher headquarters, adjacent units, attached units, supporting units, and subordinate units.

#### 1.2.3 PROCESS OPERATIONAL CAPABILITY

DEFINITION: A measure of the process ability to aid the user in performing his functions.

MEASURE: Player load and player proficiency per unit time of training.

ASSUMPTION: The user functions are identifiable.

#### 1.2.3.1 CAPACITY

DEFINITION: The output of the training process in number of players per unit time given a controller/player ratio.

MEASURES:

- ° Number of players meeting training criteria
- ° Number of controllers in training process
- ° Training time

ASSUMPTIONS: Training criteria are known

##### 1.2.3.1.1 NUMBER OF PLAYERS

DEFINITION: The number of players that can be training simultaneously.

MEASURE: Described in definition

ASSUMPTION: None

##### 1.2.3.1.2 TRAINING RATE

DEFINITION: The number of players to be processed per unit time.

MEASURE: Described in definition

ASSUMPTIONS: The unit of time can be defined.

##### 1.2.3.1.3 TIME

DEFINITION: The hours necessary to effect a desired change in C/C expertise per unit time.

MEASURE: Described in definition.

ASSUMPTION: The desired change in C/C expertise can be identified.

#### 1.2.3.1.4 NUMBER OF CONTROLLER

DEFINITION: The number of controllers used in a training scenario.

MEASURE: Described in definition

ASSUMPTIONS: None

#### 1.2.3.2 PERFORMANCE ASSESSMENT

DEFINITION: The ability of the process to provide data elements that are required for player evaluation.

MEASURE: The data elements present for evaluation compared to the number required.

ASSUMPTIONS: The number of data elements required for performance evaluation is known.

##### 1.2.3.2.1 EVALUATION

DEFINITION: Determining the performance potential of the player to handle a tactical situation.

MEASURE: The number of evaluation tools provided by the process compared to those required to evaluate the players potential.

ASSUMPTION: Data items required to evaluate the player potential can be measured.

##### 1.2.3.2.2 CRITIQUE

DEFINITION: The application of the evaluation..

MEASURE: A performance rating.

**ASSUMPTIONS:**

- 'Expert' raters are available to render a judgement.
- Criteria for raters evaluation is known.

**1.2.3.3 FLEXIBILITY**

**DEFINITION:** The capability of the process to meet the variations associated with the training objectives for all training exercises.

**MEASURE:** The number of available requirements compared to the number required in a training exercise.

**ASSUMPTIONS:** The number of requirements for a training exercise can be determined.

**1.2.3.3.1 INTRA-MISSION**

**DEFINITION:** The capability of the system to provide required controller/player action options within a mission.

**MEASURE:** The controller/player action options available compared to those required.

**ASSUMPTIONS:** The required action options for reinitiation and modification potential are defined.

**1.2.3.3.1.0.1 REINITIATION**

**DEFINITION:** The capability to select and replay portions of the training mission.

**MEASURE:** The percentage of the training mission that can be replayed.

**ASSUMPTIONS:** The capability to reinitiate the system by the controller exists.

#### 1.2.3.3.1.0.2 MODIFICATION POTENTIAL

DEFINITION: The capability of the system to expand to meet the requirements of increased controller/player interactions.

MEASURE: An expert judgement of the probability of success of modifying the existing process to incorporate modified controller/player interaction.

ASSUMPTIONS:

- ° The exercise capability of the system will need modification.
- ° 'Experts' will be available to render an expert judgement.

#### 1.2.3.3.2 INTER-MISSION

DEFINITION: The process capability to support the reconfiguration required for a new training mission.

MEASURE: The number of reconfiguration capabilities provided by the process compared to those required.

ASSUMPTION: All the possible items associated with reconfiguration will be identified.

#### 1.2.3.3.2.0.1 RESTART

DEFINITION: The total implementation of a new training exercise within a reasonable time.

MEASURE: The number of capabilities for all training exercises that can be implemented compared to those required.

**ASSUMPTIONS:**

- ° The capabilities required for all training exercises can be identified and implemented.
- ° The meaning of a reasonable time frame can be defined.

**1.2.3.3.2.0.2 FACILITY SET UP**

**DEFINITION:** The capability of the facility to permit implementation of all requirements for all training exercises.

**MEASURE:** The number of possible training requirements that can be implemented compared to the number of training requirements that have been identified.

**ASSUMPTIONS:** All the training requirements for all training exercises can be identified.

**1.2.3.3.2.0.3 EXPANSION POTENTIAL**

**DEFINITION:** The ability to add and increase exercise capability to implement new training mission requirements.

**MEASURE:** The probability that all possible training exercises can be implemented on the training process.

**ASSUMPTIONS:** All the possible training exercises can be identified.

**1.2.4 PROCESS SUPPORTABILITY**

**DEFINITION:** A measure of resources required for the process operation.

**MEASURE:** Percent of change in resources as compared with the baseline.

**ASSUMPTION:** A baseline for required resources can be established.

#### 1.2.4.1 PERSONNEL SUBSYSTEM

DEFINITION: All personnel required to support the training process.

MEASURE: The probability that the personnel in the TDA can meet the actual requirements in the process.

ASSUMPTIONS: TDA has been established for the training process.

#### 1.2.3.1.1 CONTROLLER

DEFINITION: Personnel required to conduct and monitor training exercises and to critique and evaluate player performances.

MEASURE: The number of controllers required to perform the requirements stated in the definition.

ASSUMPTIONS: Controllers can be adequately trained.

#### 1.2.4.1.2 MAINTENANCE

DEFINITION: Personnel required to operate and maintain equipment supporting the training. Subsystems requiring maintenance include Hardware, Software, and Facilities.

MEASURE: The number of personnel for each subsystem.

ASSUMPTIONS: All the subsystems that require maintenance can be identified.

#### 1.2.4.1.3 TRAINING SUPPORT STAFF

DEFINITION: Personnel required to indirectly support training. Factors to be considered with respect to the training support staff are:

(a) clerical, (b) security, (c) military administration, and (d) civilian administration.

MEASURE: Number of training support personnel required.

ASSUMPTIONS: Personnel are required to provide indirect support for training.

#### 1.2.4.2 INDIRECT TRAINING SUPPORT

DEFINITION: All support required in the training process not directly related to classroom instruction.

MEASURE: TO&E/or TDA

ASSUMPTIONS: A complete TO&E/or TDA exists for the training process.

#### 1.2.4.3 TRAINING MATERIAL

DEFINITION: The physical resources required to directly support the training process.

MEASURE: TO&E/or TDA

ASSUMPTIONS: The TO&E/or TDA has been determined for the training process.